# The Engineer.

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## The Engineer

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UNIVERSITY OF LONDON.

**King's College.**

FACULTY OF ENGINEERING.

CIVIL, MECHANICAL, ELECTRICAL and CHEMICAL ENGINEERING.

COMPLETE COURSES of STUDY, extending over three years, are arranged for the Engineering Degrees of the University of London and for the Diplomas and Certificate of the College.

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Professor J. K. CATTERSON-SMITH, M.Eng., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Senior Lecturer in Electrical Engineering.
Professor G. COOK, D.Sc., M.I. Mech. E., M. Inst. C.E., Mechanical Engineering.
S. J. DAVIES, M.Sc., Ph.D., M.I. Mech. E., Reader in Mechanical Engineering.
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Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the four Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 7286

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GLASGOW.
DEPARTMENTS OF ENGINEERING.

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Associate Professor WILLIAM KERR, Ph.D., A.R.T.C., M.I. Mech. E.
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Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
Civil Engineering:—
Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
Mining Engineering:—
Professor DANIEL BURNS, M. Inst. M.E.
Chemical Engineering:—
Professor of Technical Chemistry: THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.

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Composition fee, 25 guineas per annum.

SESSION 1931-32 BEGINS on TUESDAY, SEPTEMBER 22nd.

Calendar, by post, 3s., and prospectus, gratis, may be obtained on application to the SECRETARY. 7223

**University of Birmingham.**

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"Chance" Professor: S. LEES, M.A. (Cantab.), A.M.I. Mech. E.

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"Beale" Professor: CYRIL BATHO, M.Sc., D.Sc. (McGill), B.Eng., M. Inst. C.E.

III. ELECTRICAL ENGINEERING.
Professor: WM. CRAMP, D.Sc., M.I.E.E.

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For detailed syllabus of the Faculty apply to the REGISTRAR. 7303

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ELECTRICAL ENGINEERING — Prof. DAVID ROBERTSON, D.Sc., M.I.E.E.
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GEOLOGY—Prof. S. H. REYNOLDS, M.A., Sc.D.
CHEMISTRY—Prof. F. FRANCIS, D.Sc., Ph.D., F.I.C.

Full particulars of Courses and of the University Halls of Residence may be obtained on application to the REGISTRAR, M.V.T. College, Bristol.

The SESSION 1931-32 COMMENCES on OCTOBER 2nd. 7226

**University College of Swansea.**
(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES).

Principal: C. A. EDWARDS, D.Sc., F.R.S.

APPLIED SCIENCE DEPARTMENTS.
ENGINEERING.

Professor: FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
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Lecturer in Civil Engineering: A. A. FORDHAM, B.Sc. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Assistant Lecturer: J. SELWYN CASWELL, M.Sc. (Wales), A.M.I. Mech. E.

METALLURGY.
Professor: C. A. EDWARDS, D.Sc. (Manchester), F.R.S.
Assistant Professor: L. TAVERNER, A.R.S.M.
Lecturer: R. HIGGINS, Ph.D. (Glasgow).
Assistant Lecturers: R. GRIFFITHS, M.Sc. (Wales). A. E. W. SMITH, Ph.D. (Birmingham).

The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The Manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the Works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to Works of practical educational value to the Students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgy; and (2) for Diplomas of the College in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgy.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such classes.

Entrance Scholarships will be offered for competition in April, 1932.

Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.

EDWIN DREW,
Registrar.

Singleton Park, Swansea. 7224

### PUBLIC NOTICES.

**Hull Education Committee.**

MUNICIPAL TECHNICAL COLLEGE.

ASSISTANT LECTURER IN MECHANICAL ENGINEERING.

An ASSISTANT LECTURER is REQUIRED in MECHANICAL ENGINEERING. Experience with Automobile or Aircraft Internal Combustion Engines will be a recommendation. Salary in accordance with the Burnham Scale.

Forms of application, obtainable from the undersigned on receipt of a stamped addressed foolscap envelope, must be returned to these offices not later than the 15th August.

R. C. MOORE,
Director of Education.

Education Offices,
Guildhall, Hull,
21st July, 1931. 7324

CITY OF
**Worcester Education Committee.**

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Further particulars and application forms may be obtained from the undersigned on receipt of stamped addressed envelope.

F. E. CHANDLER,
Secretary for Education.

Tudor House, Worcester. 7325

**The Manchester Steam Users' Association.**

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### PUBLIC NOTICES.

**City of Leicester.**

TO LAUNDRY ENGINEERS.

TENDERS are INVITED for the SUPPLY, DELIVERY and ERECTION of LAUNDRY EQUIPMENT at the Swain-street Institution, Leicester, including Laundry Machinery, Power Transmission Gear, Pipe Work, Electric Power and Wiring, and Accessories.

Conditions of contract, specification, and form of Tender, &c., may be obtained from the undersigned on payment of £2, which will be returned on receipt of a bona fide Tender.

Cheques, &c., to be made payable to the City Treasurer.

Tenders, enclosed in the official envelope provided, must be delivered at the City Surveyor's Office, Town Hall, Leicester, not later than 10 a.m. on Tuesday, September 1st, 1931.

The Corporation do not bind themselves to accept the lowest or any Tender.

A. T. GOOSEMAN, M. Inst. C.E.,
City Engineer and Surveyor.

Town Hall, Leicester,
1st August, 1931. 7351

**County Borough of Swansea.**

MAIN DRAINAGE SCHEME.

CONTRACT No. 8.—WORKS FROM MUMBLES HEAD TO BRYNMILL.

The Corporation invite TENDERS for the CONSTRUCTION of SEWERAGE WORKS approximately as follows:—

| | | |
|---|---|---|
| 765 Yds. Lin. | | Twin 60in. dia. Cast Iron Pipes in 8cm Outfall across foreshore. |
| 695 | .. .. | Storage Tanks, Four Tanks abreast, each tank approx 16ft. 6in. wide by 10ft. high, in tunnel in Mumbles Hill (limestone), lined in blue brick and concrete, including Penstock and Screening Chambers. |
| 1200 | .. .. | Brick and Concrete Ovoid Sewer, 7ft. 9in. by 5ft. 2in., in trench. |
| 3042 | .. .. | Brick and Concrete Ovoid Sewer, 7ft. 6in. by 5ft., part in tunnel. |
| 1980 | .. .. | Brick and Concrete Circular Sewer, 5ft. 6in. dia., in trench. |
| 44 No. | | Brick Manholes and Overflow Chambers; |

together with Cast Iron Syphons, Stream Diversions, Culverts, Foreshore and other incidental works.

The whole of the works are UNEMPLOYMENT RELIEF WORKS, and will be subject to certain conditions laid down by the Government Unemployment Grants Committee.

On and after the 5th August, 1931, plans may be seen and specification, form of Tender, bills of quantities and a set of selected drawings obtained, at the Office of the Chief Engineer, Mr. J. Richard Heath, Guildhall, Swansea, on deposit of Ten Guineas, which will be returned on receipt of a bona fide Tender (not subsequently withdrawn), together with the specification, bills of quantities, and set of drawings.

The documents and Tender, which must be enclosed in a registered envelope endorsed "Main Drainage, Contract No. 8," must be received by the undersigned not later than Twelve Noon on the 25th August, 1931.

The lowest or any Tender will not necessarily be accepted.

H. L. LANG-COATH,
Town Clerk.

Guildhall,
Swansea,
July, 1931. 7332

**River Severn Catchment Board.**

APPOINTMENT OF ENGINEER.

APPLICATIONS are INVITED from engineers experienced in Land Drainage, River (Tidal and Non-tidal) Embankments, and Sea Defence Works, for the APPOINTMENT of ENGINEER to the River Severn Catchment Board. The person appointed will be required to devote his whole time to the duties of the office, and the appointment will be determinable by three months' written notice on either side.

The salary will be at the rate of £1000 per annum, plus travelling expenses, and office accommodation and clerical assistance will be provided.

Canvassing, either directly or indirectly, will disqualify.

Applications, stating age, experience, and qualifications, with copies of not more than three recent testimonials, must be forwarded to me endorsed "Severn Catchment Board," not later than Saturday, 22nd August, 1931.

C. H. BIRD,
Acting Clerk of the Board.

Shirehall, Worcester,
27th July, 1931. 7322

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For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

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GRINDING WHEEL SALESMAN, for London District. Man with live connection. Own car an advantage, but not essential. Would consider man representing non-competitive lines.—Address, P1363, The Engineer Office. P1363 A


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## PUBLIC NOTICE

# Government of Bombay.

## NOTICE.

**To IRRIGATION DEPARTMENTS, PORT AUTHORITIES, RAILWAYS, MUNICIPALITIES, ELECTRIC SUPPLY COMPANIES, PUBLIC WORKS CONTRACTORS AND OTHER ADMINISTRATIONS CARRYING OUT LARGE ENGINEERING WORKS.**

Notice is hereby given that, owing to the approaching completion of the Lloyd Barrage at Sukkur, large quantities of Plant and Machinery as briefly detailed in the list below will shortly become available for sale. The bulk of the plant will not be available until after June, 1931, but some plant is now available and other plant will become available shortly.

All Administrations who have works in progress or who are contemplating works in the near future are invited to consider the subjoined list and to apply to the undersigned for full particulars and prices of any plant which might be of use to them. Enquiries are not invited from machinery dealers at the present stage. Most of the plant was purchased new for these works and is in excellent condition. Every item of plant sold will be first overhauled and put in thorough working order before sale and will be open for inspection (and test, wherever possible) by appointment at Sukkur.

Service will also be given after sale and purchasers' men will be trained by arrangements, as long as the Barrage Construction Works and Shops are in existence.

A. A. MUSTO,
C.I.E., M.I.C.E., I.S.E.,
Superintending Engineer, Lloyd Barrage Circle.

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## LIST OF PLANT & MACHINERY.

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P1370 I

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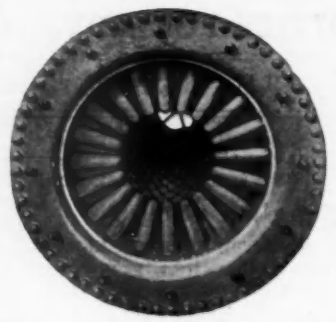

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# A Seven-Day Journal

## Restrictions in the Output of Tin.

THE scheme for restricting the output of tin, organised some months ago by the International Tin Committee, has been considerably strengthened by the recent adherence of Siam. The Dutch East Indies, Bolivia, and Nigeria have already accepted the conditions put forwrad, and the inclusion of Siam will bring the output of tin under Government control up to about 92 per cent. of the world's total resources. The importance of this development is shown in a statement issued by the Committee, which says that of the non-participating countries Siam was the only one capable of increasing production in the industry. The output of that country in 1929 was 11,124 tons, while in 1930 production reached 13,000 tons. The remaining sources of non-controlled supplies—Cornwall, Australia, and Indo-China—are said to have been compelled by the depression in the international market to reduce production to an even greater extent than has been the case with the participating countries. The effect on the world output of the metal as a result of Siam's agreement is estimated to be a reduction of about 3000 tons per annum.

## A Proposed Memorial to Sir Joseph Swan.

A COMMITTEE has recently been formed to organise an appeal for a national memorial to Joseph Wilson Swan, the inventor of the incandescent electric lamp and a pioneer in photography and the processes of photographic printing. The Institution of Electrical Engineers, of which Sir Joseph Swan was President in 1898, is presenting to the Borough of Sunderland a bronze tablet which is to be erected in the entrance hall of the Sunderland Central Public Library, Museum, and Art Gallery. A committee representing the bodies above mentioned and Swan's native town of Sunderland is also appealing for a sum of £5000 with which to found National Swan Memorial Scholarships in electrical engineering science. The fund will be administered by the Institution of Electrical Engineers, the interest on the capital named being devoted to providing the necessary funds for the scholarships which are to be founded.

## Rationalisation in the Shipbuilding Industry.

THE statement of National Shipbuilders' Security, Ltd., that it has purchased for dismantling eight shipyards on the North-East Coast, having a total of thirty-nine berths, with a maximum output capacity of 276,000 tons, marks a further step in the direction of rationalising the British shipbuilding industry. Hitherto, with the exception of one Lowestoft yard, the yards previously selected for purchase and dismantling were all Clyde establishments, but the latest purchase, all of them cargo boat-building yards in the North-East Coast area, gives point to the claim of the purchasing company that its object is to secure an orderly and proportionate curtailment of capacity in the various shipbuilding centres. The yards to be closed down include the old Ropner yard of Smith's Dock Company, Ltd., at Stockton-on-Tees; the yard of Craig, Taylor and Co., Ltd., also at Stockton-on-Tees; and the Middlesbrough yard of the Cleveland Shipbuilding Company, Ltd. At Whitby the yard of the Whitby Shipbuilding Company, Ltd., is to be closed; while further yards to be dismantled are the yard of Osborne, Graham and Co., Ltd., at Sunderland, the Lawe Shipyard of Charles Rennoldson and Co., Ltd., of South Shields, the Hebburn yard of Renwick and Dalgliesh, and the yard of the Northumberland Shipbuilding Company, Ltd., at Howden-on-Tyne. Smith's Dock Company, Ltd., intends to concentrate its shipbuilding activities at its South Bank yard on the Tees, while the ship-repairing side of its business will be continued both at North Shields and on the Tees. Since National Shipbuilders' Security, Ltd., began its operations a year ago, it has dealt with no less than seventy-one building berths, having a capacity output of almost 500,000 tons. At the annual shareholders' meeting, which was to be held yesterday (Thursday), a further statement as to the company and its activities was expected to be made.

## The New Airway Terminus at Victoria.

THE Airway Terminus of Imperial Airways, Ltd., was last week moved from the original Haymarket Office, which will now be used as a branch booking office, to the new executive offices of the company at the entrance to the continental departure platform of the Southern Railway Company's Victoria Station. The new terminus, which includes booking offices, lounges, waiting-rooms, and buffet facilities, is now connected to the railway station by a covered awning and fast saloon coaches are provided for the transport of passengers to and from Victoria and the Croydon Aerodrome. The easier access to the Croydon air port has made a saving of approximately five minutes in the journey, while the service of the newer and faster four-engined air liners of Imperial Airways, Ltd., has made possible a saving of fifteen minutes in the flight between Croydon and Le Bourget. The new arrangements therefore give a twenty minute saving in the time between the West End of London and the centre of Paris, which time has now been reduced to 3 hours 40 min. The Victoria district, with the airway and railway traffic facilities above referred to, and with the approaching completion of the new terminus for London's coastal road traffic, is rapidly becoming London's most important departure and arrival centre for either road, rail, or air transport. Passengers arriving by train from the South of England, on their way to the Continent or the Colonies by the Imperial Airways services, will find that the new airway terminus facilities contribute towards a still higher standard of speed and comfort in air travel.

## Large Scale Mine Amalgamations.

A STATEMENT dealing with colliery amalgamation, which has been drawn up by the Coal Mines Reorganisation Commission, was during the week-end circulated to owners of coal mines. The object of the memorandum is to make a preliminary survey of the ground and to put forward some tentative proposals which will serve as a basis for later discussions. The view of the Commission is that large-scale amalgamations should take place so that costs can be reduced by a concentration of productive effort. In its opinion, more pits should work at fuller capacity, and some might with advantage stop work temporarily, if not permanently. The Commission intends visiting the mining districts in the early autumn for the purpose of discussing with coalowners the submissions which are made in the present statement. A system of regional grouping is favoured by the Commission, and the memorandum gives details and figures relating to six of the largest possible natural groupings. These are:—Scotland, consisting of the Ayr, Lanark, Fife, and Lothian coalfield; South Wales; Northumberland and Durham; the East Midlands, including Yorkshire, North Derbyshire, and Nottinghamshire; Lancashire and Cheshire; and the Central Midland area, comprising Shropshire, North Staffordshire, South Staffordshire, Worcestershire, Warwickshire, South Derbyshire, and Leicestershire. Apart from the six large natural groupings above outlined, the Commission gives attention to the coalfields of the Forest of Dean, Bristol, and Somerset, Kent, Cumberland, and North Wales, and it makes the suggestion that internal circumstances, coupled with the smallness of output, indicate that in none of these coalfields is there room for more than one single output, while the districts of Bristol and Somerset must for this purpose be considered as one district.

## The Scottish Shale Oil Industry.

IN a Journal note of July 24th we recorded the decision of the Government with regard to the Scottish shale oil industry, and stated that it had been found impracticable to give any financial assistance to that industry. Since that time several of the works have been closed down owing to the uncertain future of the industry. On Wednesday last, August 5th, a deputation from the West Lothian County Council and the Mid-Lothian County Council was received by the President of the Board of Trade, Mr. William Graham, and the Secretary for Mines, Mr. Shinwell. The deputation was introduced by Major Colville, member of Parliament for North Mid-Lothian, who explained that the purpose of the deputation was to persuade the Government to come to the assistance of the industry in some form or other. The very serious effect on the position of the local authorities brought about by the contraction of the shale oil industry was placed before the Ministers, and various suggestions for dealing with the situation were put forward, and the difficulties involved in applying them were discussed. The meeting occupied close upon two hours. At the conclusion of the conference the President of the Board of Trade stated that the suggestions which had been put forward would be fully considered by the Government and a reply to the deputation would be sent at the earliest possible date.

## Progress in Electrical Precipitation.

THE announcement is made that as the result of recent negotiations an agreement has been entered into by the principal firms in Britain, Europe, and America, which have specialised in developing electrical methods of cleaning gases and air, with a view to bringing the art of electrical precipitation up to its fullest perfection. In our own country, Lodge-Cottrell, Ltd., of London and Birmingham, have operated the patents of Sir Oliver Lodge, Dr. F. G. Cottrell, and Dr. Erwin Möller, while in America similar work has been done by the International Precipitation Company, of Los Angeles, California, and the Research Corporation of New York. On the Continent, particularly in Germany, electrical precipitation methods have been developed to a large extent by the Lurgi Apparatebau G.m.b.H., of Frankfurt-on-Main, and the Siemens-Schuckert Werke, of Berlin. In the past the American companies, which had developed the process to a large extent, had always favoured the idea of exchanging experience with designers and operators of precipitation plants in other countries, but only a loose co-operation had existed with certain firms, while others were outside. According to the new agreement, the participating firms have resolved to exchange all patents and working experience and to support each other in every way with a view to developing the electrical method of cleaning gases. With the increasing size of power stations and industrial plants, a large field is presented in the electrical removal of dust from flue gases. It is to be hoped that the international co-operation above referred to will further help in the solution of this and other similar problems.

## Television in New York.

A NEW television transmitting station has just been opened in New York, and entertainers are now performing before the microphone and the television camera. In the station building good pictures of the entertainers are said to be obtained, but 14 miles away they leave much to be desired, and the engineers are endeavouring to learn what happens to television images as they are transmitted over the steel structures of the New York buildings. A study is to be made of the cause of interference, and particular attention is to be paid to the question of whether electric tramcars, electric signs, and lifts are in any way responsible for the imperfect reception. The new station, which is the sixth of its kind established in New York, works at a frequency of 2750 kilocycles and the apparatus is rated at 500 watts.

## Science and the State.

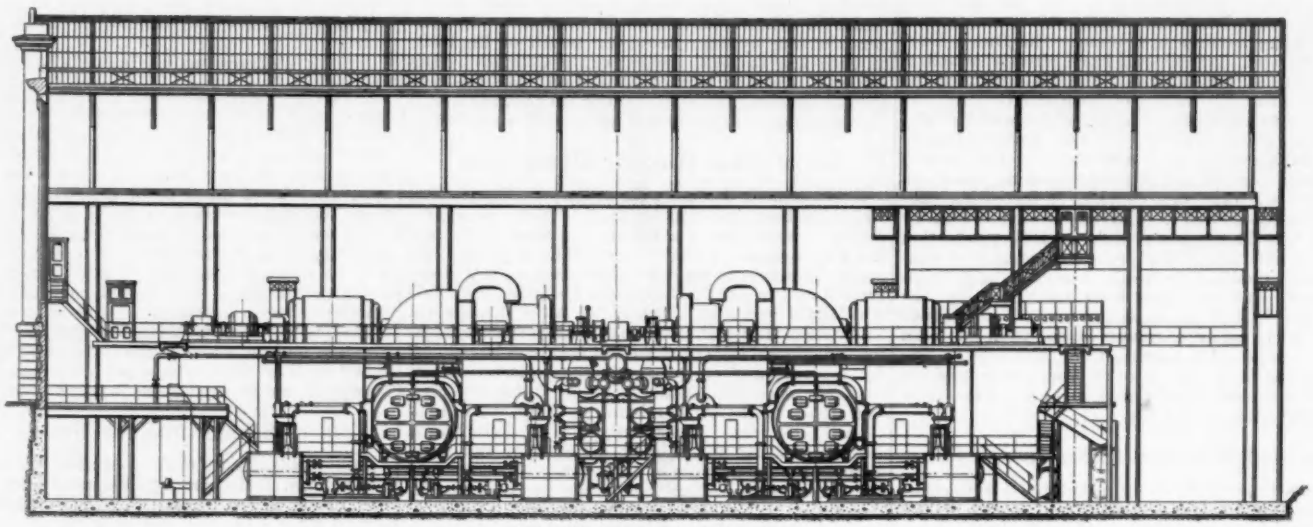
IN a Journal note of May 8th last we referred to Sir Richard Redmayne's presidential address to the Institution of Professional Civil Servants, and to his appeal for a more generous appreciation of the work and worth of technical and scientific men in the service of the State. The Institution has just issued a memorandum on the report of the Royal Commission on Civil Service, which report it views with profound disappointment. It may be recalled that the Institution put forward as evidence before the Commission a comprehensive scheme for the organisation of the technical Departments of State service on the lines of those recently recommended by a Committee appointed to inquire into the Government scientific establishments. These proposals, the Institution points out, were practically rejected by the Commission. The considered view of the Institution is that the employment of experts in public departments is a problem of complex character, which requires for its proper solution a special commission or committee. The failure of the Commissioners to realise the essential unity of function of specialised officers and their work, and the place of scientific knowledge and method in the modern community, is deplored by the Institution, which directs attention to the small amount of space devoted by the Commissioners to the consideration of questions affecting the professional scientific and technical classes. A similar tendency is, we suggest, to be noted in the proposals of the Economy Committee, which advocates reductions of expenditure or discontinuance of support for programmes of research and development connected with defence, mechanical transport, civil aircraft, agriculture and fisheries, and the reduction of grants now made to universities and colleges.

## Oil from Coal.

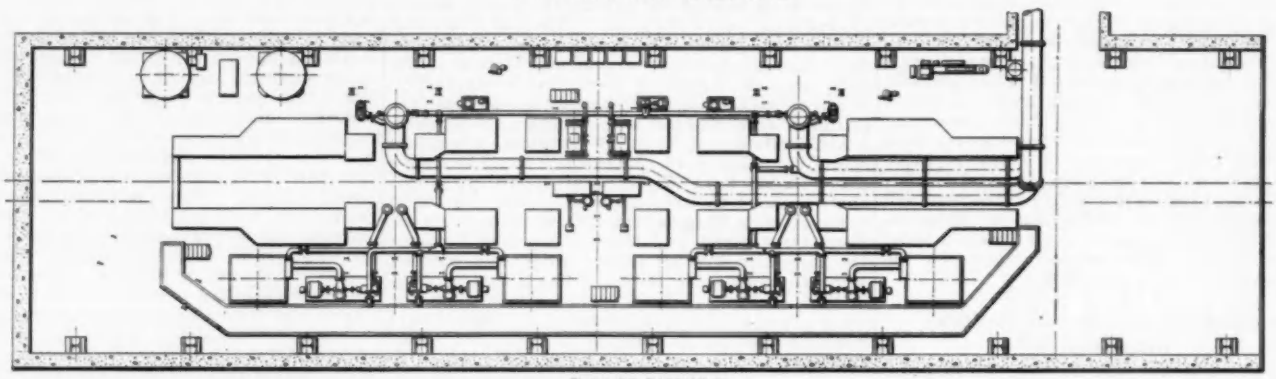
IN a recent letter to *The Times*, Professor F. G. Donnan called attention to the importance of the hydrogenation process for the production of petrol and fuel oils from British coal. During the last five or six years that process has been carefully investigated at the Billingham works of Imperial Chemical Industries, Ltd., on a 20-ton per day plant, with which work Professor Donnan has been in touch. The experimental plant has demonstrated the commercial feasibility of manufacturing high-grade petrol and other oils from British coal. A point has now been reached, Professor Donnan stated, at which commercial production is justifiable and should in the national interest be taken up. A plant designed to treat about 1000 tons of coal per day, producing 213,000 tons of petrol per year from British coal, would require both for treatment and for its operation about 850,000 tons of coal each year. A plant of this type, it has been calculated, would give permanent employment to 5000 men, of whom 3000 would be miners, while its construction would give further employment to some 17,000 men during a period of two years. Professor Donnan considers that the security and future prosperity of our country urgently demands the erection and operation of such a plant. At the present time Great Britain consumes annually nearly 9,000,000 tons of liquid fuels of various kinds, all of which have to be imported into the country. Were we to manufacture, say, 10,000,000 tons of mixed oils by the hydrogenation of British coal, over 30,000,000 tons of coal, together with the services of nearly 200,000 men, 90,000 at the works and over 100,000 at the mines, would be required. Writing on the same subject to *The Times*, Professor J. S. S. Brame, of the Royal Naval College, Greenwich, while expressing his sympathy with the idea of home-produced liquid fuel, points out that most of the work done in Germany on hydrogenation has been carried out either with brown coals or with tars produced by carbonisation, and that investigations on tar hydrogenation are now being carried out in this country.

# KEARSLEY POWER STATION—SECTIONS AND PLANS

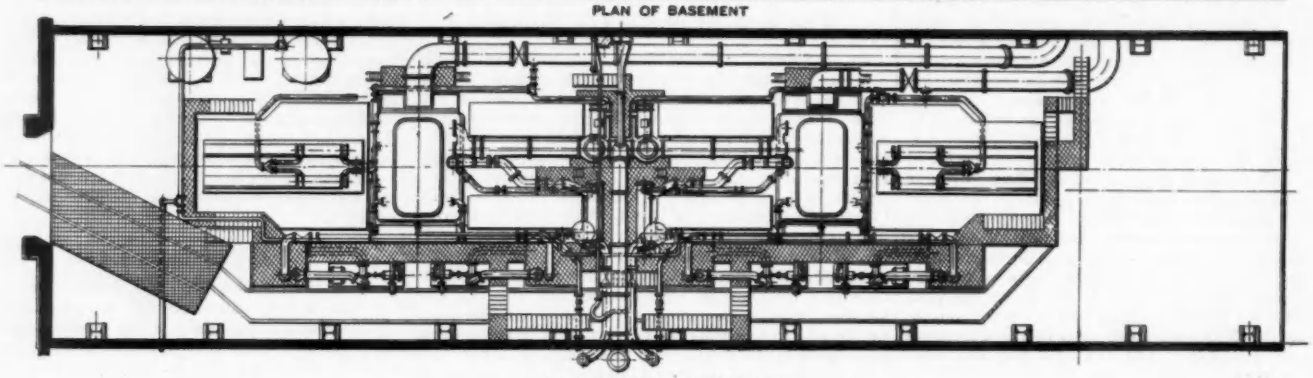
*(For description see opposite page.)*



VIEW LOOKING FROM BOILER HOUSE



PLAN OF BASEMENT



PLAN AT HEATER PLATFORM LEVEL

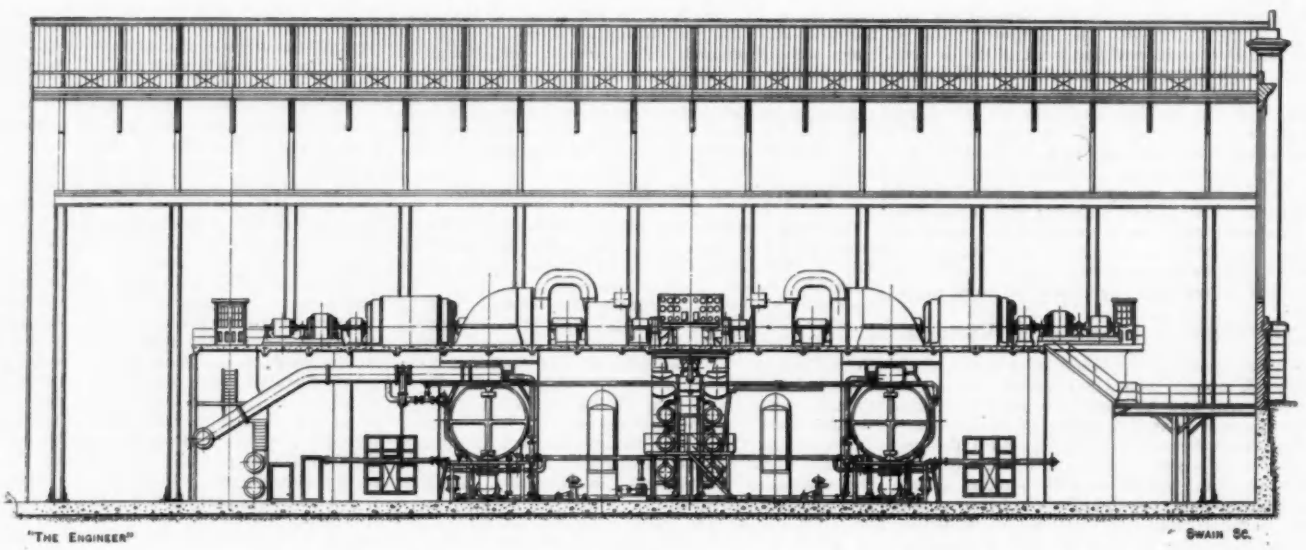


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FIG. 12

KEARSLEY POWER STATION—TURBINE ROOM

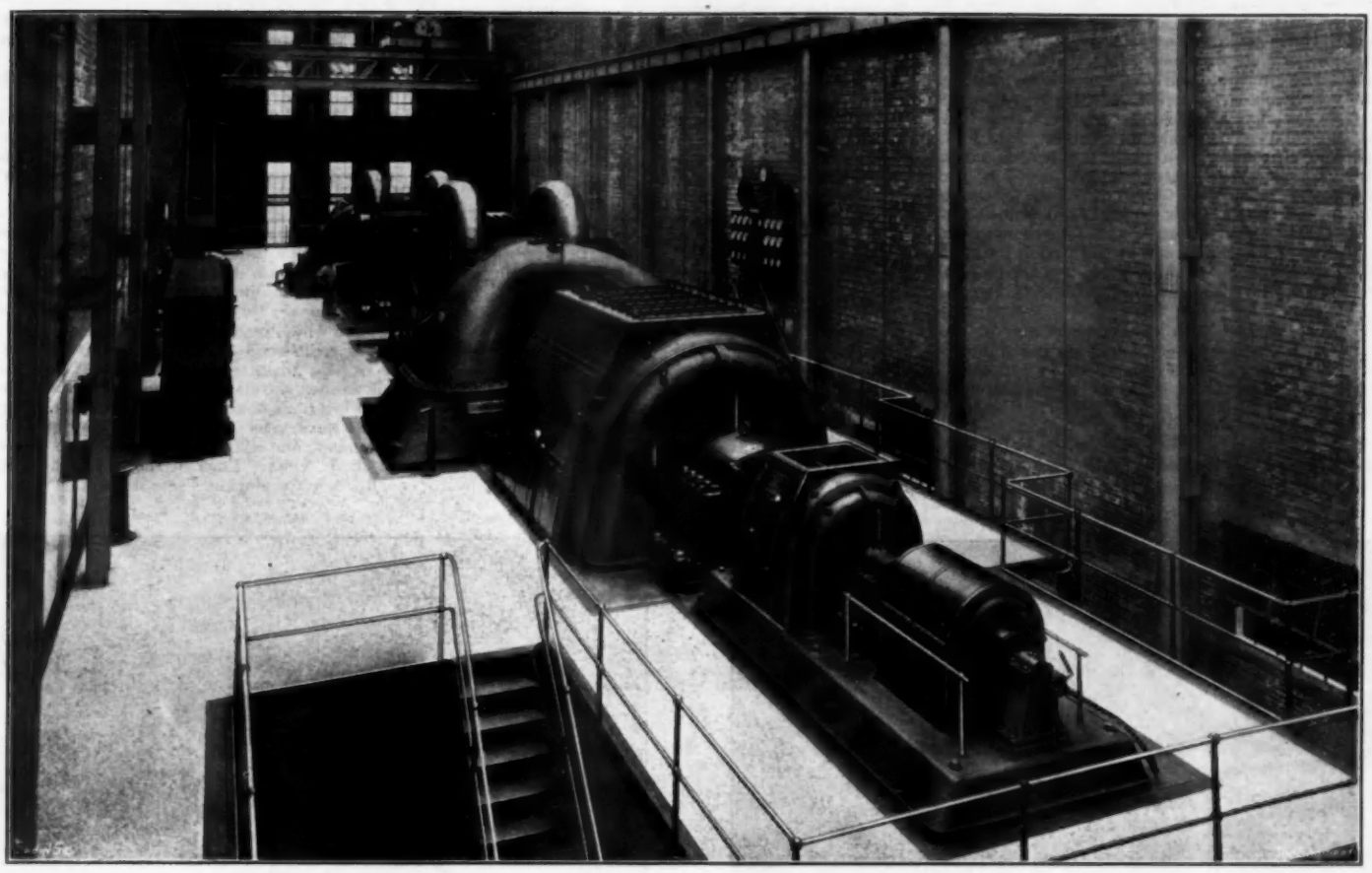


FIG. 13

# The Kearsley Power Station.

No. II. (*Conclusion*).*

CONTINUING our description of the Kearsley station, we give to-day, in a Supplement, drawings of the power-house.

As is it not our intention to describe the equipment of the Kearsley station in greater detail than is necessary for the general design of the station to be understood, and the reasons for the excellence of its performance to be appreciated, we give, in Table II., a tabulated summary of the principal facts concerning the boiler-house plant, leaving the illustrations which appeared in our last issue to tell their tale further in their own way :

TABLE II.—*Boiler-house Particulars.*

| | |
|---|---|
| Steam pressure— | |
| Safety valve loading | 337 lb. per square inch |
| Drum working pressure | 315 lb. per square inch |
| Superheater outlet pressure | 305 lb. per square inch |
| Steam temperature— | |
| Superheater outlet (normal) | 685 deg. Fah. |
| Superheater outlet (maximum) | 710 deg. Fah. |
| Heating surfaces— | |
| Boiler | 11,676 square feet |
| Superheater | 5588 square feet |
| Economiser | 8496 square feet |
| Air heater | 11,713 square feet |
| Grate area | 396 square feet |

These figures may well be followed by the data referring to a test of one of the boilers, carried out under normal operating conditions, and by the men who usually operate the plant. The boiler was not operated at a constant load but took the usual fluctuations, and at one period of the test was running at approximately 50 per cent. of its normal output for nearly an hour. The test was one of the periodic trials conducted to determine in detail what the boilers were doing under actual operating conditions.

*Boiler Test on No. 1 Boiler.*

| | | |
|---|---|---|
| Duration | | 6 hours |
| *Fuel*— | | |
| 1. Fuel | | Crumbouke washed mixture |
| 2. Total coal burnt | | 47,488 lb. |
| 3. Rate of firing | | 7915 lb./hr. |
| 4. Riddlings returned to hopper | | 1·85 per cent. |
| 5. Average thickness of fire | | 3½in. |
| 6. Residue formed (ashes and clinkers) | | 6·18 per cent. |
| 7. Combustible matter in residue | | 4·8 per cent. |
| 8. Ultimate analysis of fuel as fired :— | | |
| | Per cent. | |
| Carbon | 66·94 | |
| Hydrogen | 4·58 | |
| Oxygen | 6·54 | |
| Nitrogen | 1·06 | |
| Sulphur | 1·66 | |
| Ash | 7·30 | |
| Moisture | 11·92 | |
| | 100·00 | |
| 9. Calorific value of fuel as fired (gross) | | 12,070 B.Th.U./lb. |
| *Water*— | | |
| 10. Total water evaporated | 415,098 lb. | = 69,183 lb./hour |
| 11. Temperature of feed water to economiser | | 200·8 deg. Fah. |
| 12. Temperature of feed water from economiser | | 280 deg. Fah. |
| *Steam*— | | |
| 13. Pressure in boiler drum | | 313·4 lb./sq. in. |
| 14. Saturated steam temperature | | 427·6 deg. Fah. |
| 15. Pressure at superheater outlet | | 301·4 lb./sq. in. |
| 16. Superheated steam temperature | | 714 deg. Fah. |
| *Air*— | | |
| 17. Temperature of air supply to F.D. fan | | 81·4 deg. Fah. |
| 18. Temperature of air supply from air heater | | 198·4 deg. Fah. |
| 19. Pressure of air supply under grates | | 0·09in. W.G. |
| *Flue gases*— | | |
| 20. Average temperature, boiler outlet | | 516·2 deg. Fah. |
| Average temperature, economiser outlet | | 320·6 deg. Fah. |
| Average temperature, air heater outlet | | 234·9 deg. Fah. |
| 21. Analysis of dry flue gases, per cent. by volume :— | | |
| $CO_2$ | 11·3 | |
| CO | Nil | |
| $O_2$ | 8·1 | |
| $N,CH_4$, &c., by difference | 80·6 | |
| | 100·0 | |
| *Conclusions*— | | |
| 22. Fuel fired per square foot of grate per hour | | 19·98 lb. |
| 23. Heat generated by fuel per cubic foot of furnace volume | | 17,810 B.Th.U. |
| 24. Air used per pound of fuel | | 14·46 lb. |
| 25. Air theoretically required per pound of fuel | | 9·43 lb. |
| 26. Ratio of air used to air theoretically required | | 1·53 |
| 27. Water evaporated per pound of fuel as fired | | 8·741 lb. |
| 28. Heat absorbed by water in boiler and economiser | | 1046·1 B.Th.U./lb. |
| 29. Heat absorbed by water in economiser | | 79·2 |
| 30. Heat absorbed by steam in superheater | | 164·7 B.Th.U./lb. |
| 31. Heat transmitted per square foot of boiler heating surface | | 5729 B.Th.U./hr. |
| 32. Heat transmitted per square foot of economiser heating surface | | 645 B.Th.U./lb. |
| 33. Heat transmitted per square foot of superheater heating surface | | 2039 B.Th.U./lb |
| 34. Heat transmitted per square foot of air heater heating surface | | 275·5 B.Th.U./lb. |
| 35. Percentage of total heat recovered in air heater | | 3·38 per cent. |
| *Gross heat account*— | | |
| 36. Heat leaving boiler plant in steam, gross overall thermal efficiency | | 87·68 per cent. |
| 37. Heat lost in chimney gases, per cent.:— | | |
| (*a*) Dry products of combustion | 2·99 | |
| (*b*) Excess air | 1·54 | |
| (*c*) Moisture in fuel | 1·10 | |
| (*d*) Moisture from combustion | 3·80 | |
| Total | | 9·43 per cent. |
| 38. Heat lost by combustible matter in ashes | | 0·36 per cent. |
| 39. Balance—radiation and unmeasured | | 2·53 per cent. |
| | | 100·00 per cent. |

The boiler, as will be seen, showed the extraordinarily good efficiency of 87·68 per cent., with only 2·53 per cent. of the heat in the coal not definitely accounted for, and no item of loss with any sensible scope for reduction. The secret of the performance, if there is one, is to be explained by a good boiler unit in good condition, worked at a rating which really gives a boiler a chance to excel. The grate, it will be noticed, was burning only 19·98 lb. of fuel per square foot, with a forced draught of 0·09in. under the fire, and the evaporation was 5·9 lb. per square foot of boiler heating surface. It rests with those who are afflicted by the modern craze for high evaporation rates to show that such practice can procure efficiencies equal to those obtained at Kearsley, or, taking capital costs into account, can furnish steam as cheaply.

### THE TURBINE-ROOM.

A general view of the turbine-room showing the two main generating sets is illustrated in Fig. 13. These machines have their most economical rating at 25,000 kW at the transformer secondary. Their maximum continuous rating is 32,000 kW at 75 per cent. power factor, and 1500 revolutions per minute. The house generator, rated at 750 kW, and exciter are mounted on their own bed-plate and driven from the end of the mainshaft of the machine. As will be evident from the engraving, there is ample space and height in the turbine-room, yet the arrangement of the machinery has required only 14·5 cubic feet of space per kW installed, a figure which may be compared with the 42 cubic feet per kW installed in a large modern station in the Midlands. One of the minor nuisances that may occur in a turbine-room is that due to the sealing steam from the glands. As a rule, it is allowed to escape into the atmosphere through vent pipes, and in cold weather it condenses on the roof, doing no good to the latter and dripping back on to the machines and the floor in an unpleasant manner. Some makers now provide means for avoiding the free escape of the gland steam, but at Kearsley there is a special device which is as simple as it is effective. The idea, which is patented, consists in connecting the base of the ordinary vent pipe to some part of the circulating water system, at which the pressure is below atmospheric, by a pipe containing a hand-controlled cock and a non-return valve in series. At the end of the vent pipe a balanced flap valve has its seating. On easing back the cock, the suction through the connecting pipe at once causes the flap valve to close tightly and all steam is drawn off into the circulating water system. The operator can assure himself at any moment that the glands are properly sealed by closing the cock, when steam at once escapes from the top of the vent pipe in the ordinary way.

A view in the turbine-room basement is given in

* No. I. appeared July 31st.

Fig. 14. Here, again, will be noticed the excellent natural lighting characteristic of the station, and the convenience of supervision and access for all apparatus requiring attention. Air extraction is performed on the water-ejector system, so that the whole of the auxiliaries are electrically-driven, no steam being used anywhere except for driving the main turbines. Furthermore, although steam is used, of course, for regenerative feed heating, it is only after it has been expanded down to very low pressures. The condensate leaves the condenser at 83 deg. Fah. and is raised to 159 deg. Fah. in the first heater, which takes steam at 7·75 lb. absolute pressure. In the second heater, it is raised to 210 deg. Fah. by steam tapped off the turbine after expansion to 21 lb. absolute. At 210 deg. Fah. the water enters the economiser, thus leaving the latter plenty of work to do, and at the same time facilitating the reduction of the flue gas temperature to its normal figure of 250 deg. Fah. or less.

The control room, with the feeder panels to the left and the two generator panels on the right, is illustrated in Fig. 15. It is situated above and at the end of the turbine-room, of which it commands a complete view.

### The Operating Results.

Having now given an outline of the station, we may turn to the operating results which have made Kearsley famous as the most efficient public power station in Great Britain. The whole of the essential figures relating to the station operation during the year ending December 31st last are given in the following table :—

Table III.—*Power Station Statistics, Kearsley, Year Ended December 31st, 1930.*

| | | |
|---|---|---|
| *Output—* | | |
| 1. | Total units generated | 129,624,646 |
| 2. | Total units delivered to feeders | 123,478,306 |
| 3. | Total units used on works | 6,146,340 |
| 4. | Percentage units used on works, (3)×100÷(1) | 4·74 per cent. |
| 5. | Maximum load on feeders | 35,000 kW |
| 6. | Load factor, (2)×100÷(5)×8760 | 40·27 per cent. |
| *Fuel—* | | |
| 7. | Total weight burnt | 67,907 tons |
| 8. | Class and quality | Lancashire washed slack |
| 9. | Analysis (approximate on dry basis): | |
| | Volatile matter | 33·34 per cent. |
| | Fixed carbon | 58·29 per cent. |
| | Ash | 8·37 per cent. |
| | | 100·00 per cent. |
| | Moisture | 10·32 per cent. |
| 10. | Calorific value as fired (gross) | 12,200 B.Th.U./lb. |
| 11. | Calorific value dry (gross) | 13,605 B.Th.U./lb. |
| 12. | Coal per unit to feeders | 1·232 lb. |
| 13. | Coal per unit generated | 1·173 lb. |
| 14. | Ashes to dump | 8·79 per cent. |
| 15. | Combustible in ash | 5·59 per cent. |
| *Vacuum and Temperatures—* | | |
| 16. | Vacuum at turbo exhaust | 29·16in. Hg. |
| 17. | Temperature at turbo exhaust | 73·5 deg. Fah. |
| 18. | Temperature of circulating water inlet | 53·8 deg. Fah. |
| 19. | Temperature of circulating water outlet | 63·9 deg. Fah. |
| 20. | Maximum river temperature recorded | 75·5 deg. Fah. |
| 21. | Minimum river temperature recorded | 38·0 deg. Fah. |
| 22. | Temperature of gas leaving air heater | 234 deg. Fah. |
| 23. | Temperature of air entering air heater | 70 deg. Fah. |
| 24. | Temperature of air leaving air heater | 188 deg. Fah. |
| *Steam—* | | |
| 25. | Gauge pressure at boiler drum | 316 lb./sq. in. |
| 26. | Gauge pressure at turbine stop valve | 301 lb./sq. in. |
| 27. | Temperature at boiler stop valve | 697 deg. Fah. |
| 28. | Temperature at turbine stop valve | 684 deg. Fah. |
| *Water—* | | |
| 29. | Total evaporation | 1,294,960,200 lb. |
| 30. | Evaporation per unit to feeders | 10·487 lb. |
| 31. | Evaporation per unit generated | 9·990 lb. |
| 32. | Evaporation per pound of coal | 8·513 lb. |
| 33. | Evaporation per pound of coal from and at 212 deg. Fah. | 10·59 lb. |
| 34. | Temperature of feed water to economisers | 195 deg. Fah. |
| *Efficiencies—* | | |
| 35. | Boiler-house efficiency, (40)×100÷(36) | 83·82 per cent. |
| 36. | Turbine house efficiency, 3412×100 ÷(31)×(H. of steam) | 28·44 per cent. |
| 37. | B.Th.U. per kW to feeders, (10)×(12) | 15,030 B.Th.U. |
| 38. | B.Th.U. per kW generated, (10)×(13) | 14,310 B.Th.U. |
| 39. | Overall efficiency units to feeders, 3412×100÷(37) | 22·7 per cent. |
| 40. | Overall efficiency units generated, 3412×100÷(36) | 23·84 per cent. |

The station, as will be seen, ran through the year with a coal consumption of 1·232 lb. per saleable kWh, or only 1·173 lb. on the usual basis of units generated. These figures are incapable of being disputed or argued away. There can be no possible doubt as to the quantity of coal burnt, nor can the output of electricity be doubted either, especially as every integrating meter in the station is duplicated. We will, however, attempt no justification of the accuracy of these or any other figures, at the moment, as we shall return to the point later. A good quality of coal is used, low in ash, which counts for much, and the turbines have also the advantage of an average vacuum of over 29in. throughout the year. On the other hand, the steam pressure is low according to modern ideas, and the temperature even more so. By maintaining an overall efficiency of 23·84 per cent. on the basis of the units generated, as an average for a year with the steam conditions in question, the station has, we believe, created a world's record. In any case, it has shown itself capable of getting more out of a moderate heat cycle than other stations seem able to get out of conditions which, in theory, are much superior. An average boiler-house efficiency of 83·82 per cent., no doubt, contributes very materially to the success of Kearsley, but where all is so good it is invidious to apportion credit. A final flue gas temperature averaging only 234 deg. Fah., and a loss of less than half of 1 per cent. by unburnt combustible in the ashes leave little room for betterment.

### The Accuracy of the Records.

Only three figures, of course, are necessary to determine the thermal efficiency of a power station, namely, the weight of coal burnt, its calorific value, and the quantity of electricity turned out. At Kearsley the whole of the coal is brought in by rail and every wagon is weighed before and after dumping on an Avery weighing machine, which is maintained and tested every three months under contract by the makers. There are two such machines, one on each side of the dumping hopper, and they are checked against each other once every fortnight by weighing the same car on each. The bunkers are very narrow, and they are levelled off at the same time every day, so that the coal in them can be deducted from that brought up by the elevators. Levelling is greatly facilitated by the fact that, when the natural ridge of coal left by the conveyor has risen sufficiently for the coal just to touch the centre gangway over the bunkers, the coal when levelled will exactly fill the bunker.

The accuracy of the calorific value of the coal depends on proper sampling and testing. At Kearsley the bulk sample is taken at the point where the coal passes from the main discharge hopper to the bucket conveyors. A sampling outlet has been made in the main coal shoot for this purpose. This outlet is fitted with a slide which opens across the full width of the descending coal stream, allowing a definite slice of the stream to pass down the sampling shoot. To obtain the bulk sample the sliding door is opened and closed at regular intervals of about a minute each, during the time while ten trucks of the same quality of coal are being dumped and elevated. The sample obtained weighs about 3 cwt. Each of the different varieties of coal burnt in the station is sampled in this way.

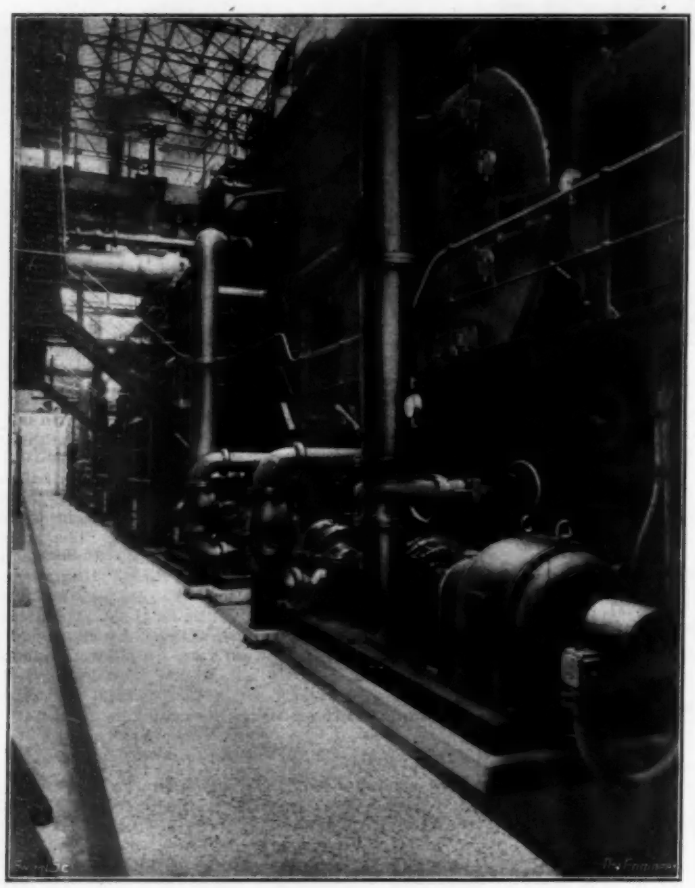


Fig. 14—Basement of Turbine Room

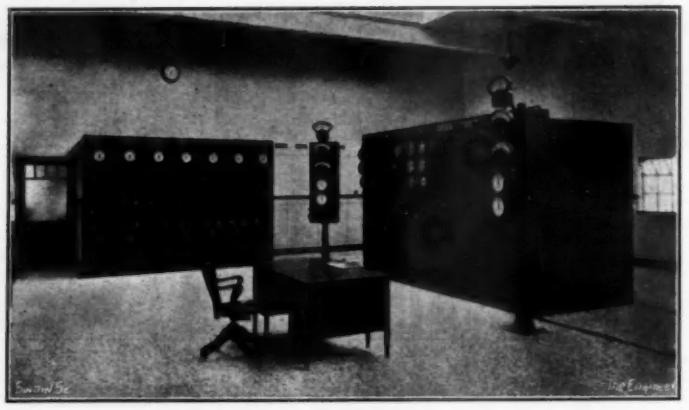


Fig. 15—Control Room

Fig. 16—Laboratory

As soon as the bulk sample has been collected it is at once removed to the special sampling room close by. Here it is quickly mixed up, and a portion, weighing about 6 lb., is placed in the drying oven for the determination of moisture. The oven contains a number of trays over which a current of warm air from the boiler-room is passed. The sample remains in the oven until it has attained a constant weight, from which the quantity of free moisture originally present can be computed. It is then ground up to pass through a screen of sixty meshes to the inch and reduced to a sample weighing from 4 oz. to 6 oz. by passing it through a funnel from which it falls on to a revolving tray. The rotation of the tray brings a receptacle periodically under the funnel and allows a small but perfectly representative sample of the original bulk to be rapidly and automatically collected. This method of reduction is convenient and effective. The reduced sample is put into an air-tight bottle and taken to the laboratory for the determination of the inherent moisture.

The remainder of the main bulk sample is passed through a grinding machine, which reduces it to about ¼in. size. It is then coned and quartered down to a quantity of about 20 lb., which is air dried in the oven. The dried sample is then reduced by another rotating tray device and ground to ¼in. size, when it is once again reduced until a sample of 4 oz. to 6 oz. remains. The whole of this is passed through an end runner mill in which it is ground until all of it will pass through a sixty-mesh screen. It is then put into an air-tight bottle and passed on to the laboratory

for the calorific value and analysis to be determined.

The procedure described is carried out once a day for each class of coal, and at the end of the week the mean calorific value and mean analysis are calculated from the whole of the individual tests. As a rule about eighteen individual tests are carried out per week.

The laboratory where coal, water, &c., are tested is illustrated in Fig. 16. On the bench at the end can be seen the bomb calorimeter. As evidence of the great care taken to ensure accuracy with this instrument it is completely enclosed in a glass case to protect it from all draughts or extraneous temperature influences. The stirring motor is fixed outside the case at the top, and readings of the thermometer are taken by a telescope through the side of the case. The enclosure of the instrument has resulted in a marked increase of accuracy, and tests can now be repeated within a very few thermal units. The laboratory is in the charge of competent chemists and is equipped with everything necessary for scientific control of the station operation. Tests of raw water, softened water, condensate, and boiler water are carried out as a matter of routine, nothing being left to judgment where scientific supervision can be usefully applied.

The third factor in the computation of station efficiency, namely, the quantity of electricity produced, is one about which there is usually no question. Nevertheless, as has already been mentioned, the whole of the integrating wattmeters in use at Kearsley are duplicated, so that any discrepancy in their readings may result in an immediate investigation into the cause.

### The Methods of Operation.

Whenever a power station shows a particularly good or bad efficiency the reason is generally to be looked for in the boiler-house. The boilers must be well operated, and for that to be possible month in and month out the whole design and lay-out must be good. At Kearsley they are of the best, as our illustrations have shown. It is no good spending thousands of pounds on instruments and scores more in trying to keep them in order if the operators have to make their way into dark, hot or awkward places to carry out their ordinary duties. No such reproach can be levelled at Kearsley. Good operation there, is rendered easy by the conditions. Very few instruments are used, the whole boiler-house being in a sense controlled from one boiler. This is fully equipped, as will be seen by its instrument board shown in Fig. 14. The principle of operation is the same as that found so successful at Padiham, which held the record for efficiency until Kearsley was put into commission. The control boiler is worked in accordance with the indications of its instruments and every other boiler under steam is worked in exactly the same way. Since all boiler units are indentical and are burning the same class of fuel at any time, what is best for one is best for all. Objections to the method are silenced in the face of an average boiler-house efficiency of nearly 84 per cent. taken over a year. Moreover, by limiting the number of instruments to a single set it is possible to employ the very best obtainable without an undue expenditure. That has been the policy at Kearsley, and although it prevents elaborate tests being carried out on any boiler at will, it enables the performance of any class of coal and the best conditions for burning it to be established for the whole set of boilers. Every boiler has, in addition to the usual gauges and fittings, a flue gas thermometer to read the temperature at the exit of the air heater.

The quantity of water evaporated in the boiler-house is obtained from the steam consumptions of the turbines, which are accurately known at all loads, as well as the necessary corrections for steam conditions and vacuum. The figures are obtained from carefully conducted tests, frequently repeated. The turbines, indeed, act as calibrated steam meters, and as such have an accuracy at least comparable with that of any other method of measuring steam or feed water. Since no steam is used in the station except to drive the main turbines, the electrical output is an almost perfect measure of the total steam consumed. Moreover, even if that were questioned, the matter is not of great importance, for any error would only affect the relation between the turbine room and boiler-house efficiency. The important thing is the efficiency of the whole station, and that does not depend in any way on the quantity of steam consumed, but only on the ratio between the heat in the fuel and the electrical output, as has already been emphasised.

The make-up feed water is obtained from the river Irwell. It is softened, first by a lime and soda treatment in a Kennicott softener and finally by a base-exchange process. It is de-aerated by admission to the condensers, for the station contains no de-aerating plant, nor is any necessary. As a consequence of the care taken with the feed water, which is at all times under the supervision of the works chemist, the boilers are never cleaned internally. The saving of labour and of heat under these conditions is, of course, very appreciable. The feed being of zero hardness, there is no possibility of scale formation in the tubes or drums, but the soluble salts naturally become concentrated in the boiler water in course of time. The boilers are therefore completely emptied after every 800 hours' steaming, when the concentration has reached a figure of 150 to 200 grains per gallon. They are due for emptying at the same time that they are due for a thorough external cleaning to remove any accumulations of flue dust and soot, so that only one stoppage is necessary. Moreover, the cooling of the boilers by emptying, much facilitates the work of the flue dust removal. Except for this work, there is no boiler cleaning in the station, leaving out of account, of course, the periodical "soot blowing" by means of steam jets.

Those members of the general public who have been persuaded that power station chimneys must necessarily cause a nuisance by the distribution of dust and grit over the surrounding neighbourhood might completely reassure themselves by a visit to Kearsley. The station is not situated in a locality where any special precautions against dust emission might be necessary, yet the chimneys are as blameless as chimneys could well be. As evidence of this, large level surfaces of the station roofs, protected moreover against winds which might sweep them clean, have been allowed to collect everything which has fallen on them since the station was built. The roof being easy of access, visitors who are interested in the soot and grit question are invited up on it to see for themselves the infinitesimal deposit which has accrued from the burning of some hundred thousand tons of coal in the boiler-house beneath. It is, moreover, possible, when standing on the roof, while soot blowing is in progress, to gaze upwards without getting grit in one's eyes, a feat which one would not care to risk with most chimneys. The result has not been attained by the use of grit catchers, for none are installed. The chimneys, moreover, are only 112ft. high from the firing floor. The downward flow of the flue gases through the economisers and air heaters before ascending the chimneys counts for much, as there is a strong tendency for grit and dust to be deposited where the gases turn upwards. But easy boiler operation and good coal are at least equally important factors. There is a low gas velocity in the flues and chimneys, so that the minimum of solids is carried along by the draught. Added to this feature, the excellence of the combustion prevents almost entirely the presence of gritty coke particles in the flue gases, while the lowness of the original ash content of the coal leaves little "fly-ash" to be carried away. Kearsley is indeed a cleanly station inside and out. The boiler-house is maintained almost as if it were an exhibition, a condition which is greatly facilitated by the excellence of the natural lighting.

Much more could be said about Kearsley, but the limitations of our space forbid. Whether its efficiency is measured in terms of coal consumption, heat consumption, or costs of producing a kilowatt hour, it takes its place easily at the head of all the public power stations in the country. As to operating costs, with coal at 15s. per ton and a consumption of only 1·173 lb. per kWh generated, the fuel cost works out to less than a tenth of a penny. That other items are correspondingly low will be readily admitted by any engineer who studies the design of the station. Capital charges, too, are very moderate, for the station, together with the land it occupies, has cost no more than £14·1 per kW of installed capacity. To build a first-class modern plant for such a price, capable of a performance equal to that of Kearsley, is certainly a feat to be proud of. To operate it in such a manner as to get the results is a feat of equal merit. Mr. Adams is to be congratulated from both points of view. He also deserves the respect of all who are interested in power station work for the extreme care taken to ensure the accuracy of the figures on which the performance of the station can be judged. They can neither be doubted nor explained away on the assumption of any specially favourable conditions, but stand as a convincing tribute to design and management.

The Kearsley station has been designed and constructed under the supervision of Dr. H. F. Parshall, the consulting engineer to the company.

In conclusion, we wish to thank Mr. C. D. Taite, the engineer and manager, and a director of the Lancashire Electric Power Company, for permission to illustrate and describe the latest and most efficient station of a company with a long record of efficiency behind it. To Mr. Adams and his staff our thanks are also due for their time and attention willingly given on the occasions of our several visits to Kearsley.

### LIST OF CONTRACTORS.

Civil Engineering and Building Work: J. Jarvis and Sons, Ltd., 8, Wormwood-street, London.

Constructional Steelwork: Ed. Wood and Co., Ltd., Trafford Park, Manchester.

Turbo-alternators and Transformers: British Thomson-Houston Company, Ltd.

Condensing Plant: Worthington-Simpson, Ltd.

Switchgear, Lighting, and Cables: British Thomson-Houston Company, Ltd.

Boilers: Babcock and Wilcox, Ltd.

Coal-handling Plant: Babcock and Wilcox, Ltd.

Water-softening Plant: Kennicott Water Softener Company.

Piping: Aiton and Co., Ltd.

Painting: R. Bowran and Co., Ltd.

Feed Pumps: W. H. Allen, Sons and Co., Ltd.

Ash-handling Plant: British Ropeway Engineering Company, Ltd.

Valves and Water Screening Plant: J. Blakeborough and Sons, Ltd.

75-Ton Crane: H. Morris, Ltd.

Refractory Materials: J. G. Stein and Co., Ltd.

Economisers: E. Green and Son, Ltd.

## Education for Salesmanship.

We give below the main conclusions expressed in the final report of Sir Francis Goodenough's Committee on "Education for Salesmanship." The report—published to-day (Friday)—is obtainable from his Majesty's Stationery Office, price 1s. 6d. net.

We believe that much can be done, in the words of our terms of reference, "for the promotion by means of education of greater efficiency in the marketing of British goods and services, at home and overseas," by the considered development of our existing educational system and commercial organisation.

While making numerous recommendations to that end, which call for early consideration and action by employers and educationists alike, we make none which seem to us of a revolutionary character, and, we may add, none of a costly nature. Our proposals aim rather at making the most efficient use of existing institutions and at securing to the nation increased value for its present heavy expenditure on education.

In particular, we make no recommendations for the establishment of "forcing houses" for the rapid production of salesmen. We are strong in our unanimous opinion that there is no "short cut" to efficiency in salesmanship. The successful conduct of commerce, either within or without the business house, and whether at home or abroad—such conduct of commerce as will secure the permanent satisfaction and confidence of the customer—calls for knowledge and wisdom derived from considerable experience as well as from sound general education. It calls also for the steady development of suitable personality by suitable education and suitable subsequent training in the principles and technique of commerce; and men and women having such personality, knowledge, wisdom and technique are not to be produced by any intensive "forcing" process.

Our findings and recommendations call for:—

(1) *Recognition by the Nation in General and by Employers in Particular* that the future industrial prosperity of this country depends upon the constant application to the problems of finding, developing, and maintaining markets for British goods and services or at least as much time, thought, and energy, and as high a degree of abilities as are applied to the problems of production and finance; and that success in the solution of these fundamental problems of marketing—or "salesmanship" in its widest sense—involves the employment in commerce of those possessing the highest qualities, alike of character and intellect, developed to the fullest degree by sound education, training, and experience.

(2) *Recognition by all Employers* of what has been proved by some, namely, that they can increase their chance of success in the sale of their goods and services and reduce rather than increase their costs of production and marketing:—

(*a*) By paying close and very thorough attention to the recruitment of their staff for the commercial side of their business, and, with that end in view, making themselves fully acquainted with the present sources of supply of recruits of good quality.

(*b*) By offering prospects, in the near as well as more distant future, that will attract the very best types of recruit for their particular purposes;

(*c*) By realising that, however naturally gifted a man may be for salesmanship, his value can be greatly enhanced by—

(i.) A sound general education—for developing in him activity of thought, receptivity to ideas and the capacity to speak and write correctly and acceptably in his own and other languages, as well as for providing him with the essential foundations of a knowledge and understanding of the world;

(ii.) a grasp of the fundamental principles of commerce and of business methods and organisation generally; and

(iii.) appropriate instruction and training in respect of his trade, his commodity—*i.e.*, goods or services—and his markets, and the best methods of selling that commodity in those markets.

(*d*) By interesting themselves constantly and thoroughly in the progress of recruits after their entry into business, and in their continued education and training either by their individual firms or through schemes organised by their trade organisations possibly in co-operation with educational institutions.

(*e*) By giving facilities within working hours for special education and training.

On the question of any cost to the employer involved in these propositions it may be said that it is not so much a question of: Can we afford to raise the standard of our commercial *personnel?* as of: Can we, under to-day's condition, afford *not* to employ the best we can get?

(3) *Recognition by Employers and by Associations of Employers* that it is their duty, alike to their country, their trade, and their individual business, to show their readiness to co-operate fully with educational authorities for the purpose of ensuring

that the educational needs of this mercantile nation are met effectively without detriment to the intellectual and cultural development of its individual citizens.

(4) *Recognition by Educationists* of the importance (*a*) of close and frequent consultation and co-operation with commerce and industry, in order to ensure on the part of the educationist the fullest possible understanding of the qualities of mind and character demanded in those who aspire to careers in business; (*b*) of taking effective steps constantly to keep business men informed of what education is doing and can do for them; and (*c*) of taking all opportunities of familiarising themselves with the conduct and conditions and needs of those vital parts of the nation's activities which are comprised in the term "business."

(5) *Recognition by Educationists* of the need for reconsideration, so far as may be necessary in the light of this report, of the curricula in the various types of school and college which deal alike with general and with commercial education, and in some instances of the orientation of the studies followed in them.

(6) *Recognition by Parents and their Children* of the attractions of a career in commerce and the possibilities which it offers of service to the community.

(7) *Recognition, by Those having the Means*, of the opportunity of service to the nation afforded by the need for liberal endowment of facilities for education and for the advancement of knowledge, upon which the successful development of the country's industries and trade must largely depend.

(8) *Recognition by all Concerned* of the fact that the problem of the education of those engaged in or aspiring to enter commerce is no less important than is education for industry.

## Lloyd's Register Year Book.

THE new edition of the Register Book issued by the Committee of Lloyd's Register of Shipping contains, as usual, particulars of the sea-going vessels of the world, of 100 tons and upwards, and also of the steel and iron vessels trading on the Great Lakes of North America, and of other vessels classed with the Society. It thus includes a record of about 33,000 steamers, motor ships, sailing vessels, and barges. The volumes also comprise many lists of value to the shipping community, such as:—Signal letters assigned to all sea-going vessels; shipbuilders and marine engineers in all countries; detailed particulars of dry and wet docks, ports, harbours, &c., in each country; telegraphic and postal addresses of about 21,000 firms connected with shipping in all parts of the world; steamers and motor ships arranged according to nationality and gross tonnage; particulars of the speed of merchant vessels capable of 12 knots and upwards; particulars of deadweight and cubic capacities of cargo steamers and motor ships; lists of vessels carrying oil in bulk; complete lists of shipowners and managers all over the world, with the names and tonnages of their respective vessels; &c. A section of the book, which is perhaps of most interest to the general public is that giving information respecting the various merchant fleets of the world.

During the last twelve months there was a decrease in the steam tonnage owned in the world of 636,099 tons, an increase of 1,335,096 tons in the motor tonnage, and a decrease in the tonnage of sailing vessels and barges of 175,601 tons, making a net increase of 523,396 tons in the total tonnage of the world. The net increase from June, 1929, to June, 1930, was 1,533,332 tons. The countries showing the largest increases for the last twelve months are:—Norway, 397,217 tons; British Dominions, 133,924 tons; Sweden, 80,731 tons; Soviet Russia, 71,740 tons; Jugo-Slavia, 59,125 tons; and Denmark, 57,251 tons. Amongst the principal maritime countries, three show decreases, viz.:—The United States, 403,625 tons; Great Britain and Ireland, 135,539 tons; and Japan, 40,463 tons.

During the seventeen years 1897–1914 the net increase in the world's steam tonnage was 26,797,000 tons, equal to 144 per cent. of the steam tonnage in existence in 1897, and the net addition during the seventeen years 1914–1931 amounted to 23,319,000 tons, equal to 51·4 per cent. of the pre-war tonnage. If a shorter period be taken for comparison, it is seen that, while during the five years 1909–1914 the world increase—8,931,000 tons—amounted to 24½ per cent. of the tonnage owned in 1909, during the five years, June, 1926, to June, 1931, the increase—6,051,000 tons—only represented 9·6 per cent. of the world tonnage at June, 1926, an average yearly increase of less than 2 per cent. A comparison of the figures for 1897 and 1914 shows that the largest increases took place in Great Britain and Ireland, 8,678,000 tons; Germany, 3,585,000 tons; United States, 3,182,000 tons; Norway, 1,392,000 tons; Japan, 1,304,000 tons; Holland, 1,131,000 tons; British Dominions, 1,046,000 tons; and Italy, 1,028,000 tons. During the period 1914–1931 the largest increase took place in the sea-going tonnage of the United States—8,329,000 tons—and that, notwithstanding a decrease of 3,221,000 tons since June, 1922. Increases of over a million tons also occurred in seven other cases, namely:—Japan, 2,568,000 tons; Norway, 2,105,000 tons; Italy, 1,844,000; Holland, 1,639,000 tons; France, 1,591,000; Great Britain and Ireland, 1,302,000 tons; and the British Dominions, 1,302,000 tons. The increase of tonnage belonging to Great Britain and Ireland represents less than 7 per cent. of the tonnage owned in 1914, whereas the increase of tonnage owned abroad represents more than 83 per cent. of the pre-war tonnage. Notwithstanding an increase of 2,440,000 tons since June, 1922, the present totals for Germany are still 909,000 tons below those for June, 1914. In 1897 Great Britain and Ireland owned nearly 55 per cent. of the world's steam and motor tonnage, but owing to the continual increase which is taking place in the tonnage owned abroad, the percentage in 1914 had declined to 41·6, and has now been reduced to 29·4.

The reduction in the tonnage of sailing vessels and barges since pre-war times, say, June, 1914, amounts to about 2,535,000 tons gross. The present percentage of such tonnage to the world's total tonnage is only 2. Of the world's tonnage of sailing vessels and barges, 749,931 tons—53·25 per cent. of the total—are now owned in the United States, and the other countries which still have an appreciable amount of such tonnage are:—Great Britain and Ireland, 109,000 tons; Canada, 93,000 tons; Finland, 68,000 tons; Italy, 62,000 tons; and France, 53,000 tons. If barges which are generally towed, and other craft included in the sailing tonnage because not fitted with engines for self-propulsion, be excluded, the world tonnage of real sailing vessels only amounts to about 674,000 tons, of which 224,000 tons—33·2 per cent. of the total—are owned in the United States, 68,000 tons are owned in Finland, and only 16,000 tons in Great Britain and Ireland.

A considerable increase has taken place in recent years in the number of sea-going steamers and motor ships of 4000 tons each and above. In 1914 there were 3608 such vessels, and now the number reaches 6630, of which 473 are of 10,000 tons and above, including 68 of 20,000 tons each and upwards. Of the 473 vessels, 239 are under the British flag. It may be noted that just under one half of the total number of steamers and motor ships in existence are of less than 1000 tons each. Of the motor ships now in existence there are 1068 of 4000 tons and above, an increase of 153 as compared with June, 1930; 201 of them are of between 8000 and 10,000 tons, and 100 are of 10,000 tons and upwards. There are 3726 vessels less than five years old, with a tonnage representing 17·3 per cent. of the total steam and motor tonnage. Vessels of twenty-five years and over amount to 8592, but their tonnage is about 200,000 less than that of the 3726 newer vessels. Of the vessels built in 1906 or before, 61·3 per cent. of their number were of less than 1000 tons each, and the average size of the others is 3004 tons; while of the vessels built during the last five years, only 41 per cent. are of less than 1000 tons each, and the average of the others reaches 5155 tons. Of the 1140 vessels of 8000 tons and upwards now in existence, 335 have been built during the last five years. Of the tonnage owned in Great Britain and Ireland, 22·5 per cent. is less than five years old. The only countries which have a larger proportion of new tonnage—less than five years old—are Norway with 33·8 per cent., and Holland with 25·3 per cent. On the other hand, France, Italy, and Japan have only between 12 and 14 per cent.; while of the United States sea-going vessels, only 5·7 per cent. is less than five years old. Of the tonnage registered in Great Britain and Ireland, 83·1 per cent. is under twenty years old, while the percentage of the tonnage owned abroad is less than 70·5.

The size group of vessels with the largest aggregate of tonnage is that of between 4000 and 6000 tons each, amounting to 19,490,239 tons, equal to 28·4 per cent. of the world's total steam and motor tonnage. The big liners—*e.g.*, those of 15,000 tons each and upwards—represent only just under 5 per cent. of the total tonnage. It may be noted, however, that 53·4 per cent. of this liner tonnage is owned in Great Britain and Ireland.

Of the particulars given concerning the type of machinery used for the propulsion of vessels, the following summary will not be without interest:—There are now 1476 steamers of 10,636,000 tons fitted with turbine engines or a combination of steam turbines and reciprocating engines, and 4080 vessels—including auxiliary vessels—of 9,431,000 tons, fitted with internal combustion engines, as compared with 730,000 tons and 220,000 tons respectively in 1914. While during the last twelve months there was an increase of 1,335,000 tons in the tonnage of motor ships, and of 223,000 tons in the tonnage of vessels fitted with steam turbines, the tonnage of steamers fitted solely with reciprocating steam engines actually decreased by 858,000 tons. The increase in the motor ship tonnage at June, 1931, as compared with June, 1925, amounted to 6,717,000 tons. Out of 8,549,827 tons of tankers, of 1000 tons gross and upwards, no less than 3,013,907 tons are fitted with oil engines; in 1926 the proportion was about 600,000 tons out of 5,598,000 tons.

An interesting feature is the comparatively large proportion of motor tonnage included in the merchant navies of some countries. While the total motor tonnage now amounts to only 13·4 per cent. of the total tonnage owned in the world—in Great Britain and Ireland 12·4 per cent.—such percentage is much higher in the Scandinavian countries, viz.:—Norway, 40·3; Denmark, 35·8; and Sweden, 31·7. Amongst the principal maritime countries, France and the United States have the smallest proportions of motor tonnage, viz., 5·3 in both cases.

An analysis of the type of machinery now employed also shows that there are recorded in the Book 199 vessels, with a total tonnage of 1,570,124 tons—included in the totals for turbine vessels—which are fitted with a combination of steam turbines and reciprocating engines. Another interesting particular is that in the case of eighty-four vessels with a tonnage of 457,090 tons, a comparatively new system of propulsion has been adopted, viz.:—Electric motors connected to the screw shaft, these motors being supplied with current from generators which are driven either by steam turbines or oil engines. Of these vessels, fifty-eight of 288,561 tons are owned in the United States, including five vessels of over 20,000 tons each. Of the 29,952 steamers and motor ships of 100 tons gross and upwards recorded in Lloyd's Register Book, 3769 are twin-screw vessels, and 130 have triple or quadruple screws.

From another table we see that there are recorded in the new Book 3914 steamers of 20,002,307 tons fitted for burning oil fuel, of which 865 of 5,545,820 tons are registered in Great Britain and Ireland and 1620 of 8,187,201 tons are registered in the United States of America. These figures, in conjunction with those given above, enable a comparison to be made between the respective employment of coal and oil fuel at the present time, as compared with 1914:—

| | 1914. Per cent. of total gross tonnage. | 1931. Per cent. of total gross tonnage. |
|---|---|---|
| Sailing vessels and sea-going barges | 8·06 | 2·01 |
| Oil, &c., in internal combustion engines | 0·45 | 13·45 |
| Oil fuel for boilers | 2·65 | 28·52 |
| Coal | 88·84 | 56·02 |
| | 100·00 | 100·00 |

It will thus be seen that only 56 per cent. of the tonnage of the world's merchant marine now depends entirely upon coal, while in 1914 the percentage was nearly 89.

The tonnage of the 1439 tankers, of 1000 tons gross and upwards, amounts to 8,549,827 tons; 405 of 2,353,327 tons are registered in Great Britain and Ireland, 394 of 2,513,070 tons are registered in the United States, and 204 of 1,450,470 tons in Norway. In addition, there are 100,314 tons of tankers of less than 1000 tons each. The tonnage of trawlers and other fishing vessels and whalers amounts to 1,009,848 tons. There are upwards of 11,000,000 tons of vessels which are not used for ordinary cargo and passenger purposes.

## Letters to the Editor.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### STANDARDISATION OF FREQUENCY AND RAILWAY TRACTION ENERGY.

SIR,—Your very excellent leading article on "Frequency Standardisation" has, I am sure, been read with a very great deal of interest by many of your readers with appreciation. The old-time fallacy of allowing various consulting engineers to put in just what they pleased, and which best suited them, is now to cost the country many millions of pounds sterling, which will undoubtedly have to be borne in the future prices of electrical energy for the industries of this country. It is indeed a very serious thing for the railways, because it is hardly possible for them to make out a good case with the old-time Yankee system of A.C.—rotary converter—D.C. "electrification," especially for the main line railways. It would be interesting if some enlightened individual could throw some light on the real reasons why the operating energy for electrified railways in this country must be limited to the very doubtful D.C. system, and also at such high voltages, which practically make the application of the flimsy overhead conductor system essential.

During a recent investigation for a 90-mile proposed steam conversion for a railway abroad, I have been most struck by the cheapness and the superior reliability which is to be obtained by the use of single-phase alternating 50-period current for the prime-operating energy. The complete absence of old-time rotary converters, saving in buildings and labour, and the simplicity of the whole scheme, makes one wonder if the anticipations of Mr. William Mordey, M. Inst. C.E., in his paper thirty years ago, are not the solution of the problem of railway traction by means of electrical energy. It is, indeed, difficult to see how the railways can be reasonably asked to spend all those millions for the installation of what appears to be just the old-time system, and which has nothing to do whatsoever with the technical researches and industries of this country.

Besides, may I add, it is surely time that we in this country really did something for our original railway locomotive industry, the bottom of which seems to have fallen out, owing to the railways being allowed to squander their working capital in building hauling machines instead of carrying passengers. Owing to the splendid organisation of the road transportation industry, the railways now have nothing to supply but "speed" and "lower charges," and these essentials cannot be brought about either by the retention of the old-time steam locomotive nor will it be accomplished by means of the equally out-of-date and old-time "electrification" methods.

WILLIAM P. DURTNALL.

London, S.E. 5, July 29th.

### PRIVATELY OWNED WAGONS.

SIR,—Mr. E. R. B. Roberts makes some remarkable statements in a letter you published from him on July 24th. He advocates a single control for all wagons, in order to secure more efficient and economical operation, and contends that we might have a substantial reduction in rail rates and the elimination of costly stoppages at collieries, which, he says, frequently occur through so-called shortage of trucks. What are the facts?

The system advocated by Mr. Roberts was tried when the railways were State controlled. Wagons were pooled and controlled. We had central administration. What happened? We had mess and muddle, as testified by the traders themselves to the Samuel Coal Commission. We saw wagons journeying empty to places where they were not wanted, taking a rest, and then going back empty whence they came. We had wagons employed to carry South Wales coal to the Midlands, and other wagons at the same time taking Midland coal to South Wales ports for shipment. We had munition works in Derbyshire standing idle for want of coal, the works being owned by a company with its own pits on the spot, whilst the coal produced was being taken to the West Country.

After the war, but before the control ceased, we had vastly more complaints about wagon "shortage" than ever we had before or have had since control, though there was much less coal and iron and related traffic for the controlled wagons to conduct. We had wagon "shortage" in a year when only 25,000,000 tons of coal was exported, under control, but without control we have had over 70,000,000 tons of export coal carried to the docks without trouble. No practical trader wants to see pooling or control again.

Mr. Roberts says the railways collect 12s. a ton, and the wagon owners 2s. a ton, on account of coal carried to London. The average is nothing near the figure given, or traders would not have 8,000,000 tons a year carried by

rail to London when shipowners are ready to carry from the Tyne or the Bristol Channel at freights of about 3s. 6d. a ton.

The privately owned wagon is on the railways, not to please the railway companies, but to please the traders; it is on the railways as a result of long experience and proved satisfaction; and it is there by statutory authority, after full and impartial inquiry.

Sheffield, August 3rd. E. T. GOOD.

### LOCOMOTIVE TESTING PLANT.

SIR,—Your recent editorial on locomotive testing brought to my mind the desirability of definitely ascertaining the best use of ashpan dampers. We have locomotives with only one—at the front—which gives no option; but on others having two, three, and four, with various designs of ashpan and grate, there should be some data comparable to that existing regarding smoke-boxes.

Practical experience dictates the best use of dampers, but it would be helpful to know just how the air currents behave under all circumstances, and I trust this data will be obtained in the proposed new plant.

August 3rd. G.W.R. DRIVER.

### MURDOCK LETTERS.

SIR,—As I am collecting material for a biography of William Murdoch or Murdock, the inventor (1754–1839), I should be grateful to any of your readers who might assist me. I am especially anxious to see any of his personal correspondence that may have survived, and I should regard it as a great favour if any who are in possession of such correspondence would allow me to peruse and copy it.

R. BARCLAY MURDOCH.

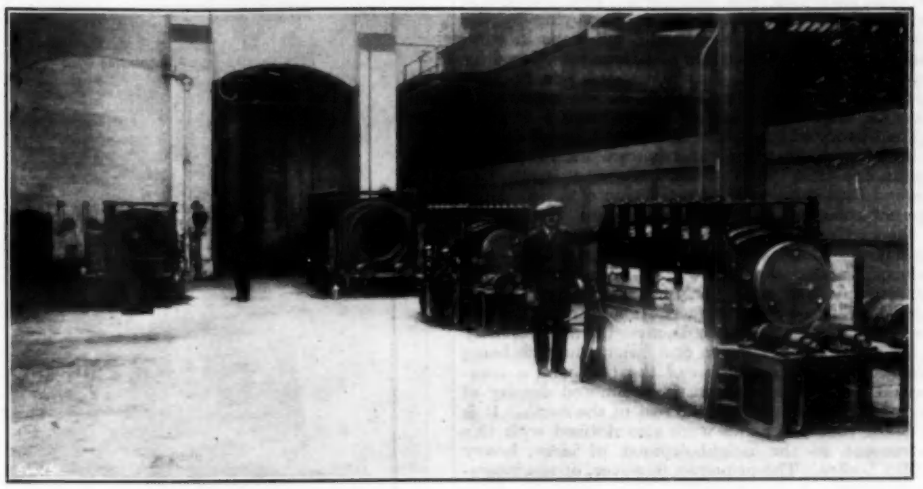
874, Aikenhead-road, Glasgow, S. 2,
July 29th.

## SIXTY YEARS AGO.

IN obedience to a popular cry, so we wrote in our issue of August 11th, 1871, it seemed to have become necessary that each year's President of the British Association should propound something to startle his hearers. At the Edinburgh meeting of that year Sir William Thomson (Lord Kelvin) had, so it appears, fulfilled expectations in this respect, although to-day there seems little that is startling in his address. Nevertheless, his speculations concerning the origin of life on the earth created astonishment and hot controversy at the time. Sir William discarded the easy, unscientific belief in spontaneous generation which satisfied many of his contemporaries. He advanced the hypothesis that life came to the earth by means of seed-bearing meteorites, which had survived the passage through the atmosphere, and that these meteorites were the fragments of another world of life. The theory, he said, might seem wild and visionary, but, he maintained, it was not unscientific. It is easy to perceive what grounds of opposition to that theory would be advanced from some quarters. There would be those who would refuse to believe that life was in the first instance manifested anywhere else than on the earth. There would be those who would be wholly disinclined to accept the implication that the many-formed life of the earth of to-day could have developed from a stray piece of protoplasm or a moss-grown aerolite. There would be others, more scientific, who would object that the theory did nothing to explain the origin of life, but only sought to account for its presence on the earth. There would be, and were, others—and among them were ourselves—who refused to agree that the theory was in the least scientific, who argued that it assumed everything and proved nothing, and therefore that it was totally opposed to the spirit of science. The broad justice of that argument can still be admitted. We cannot, however, admit as true some of the details of the scientific criticism which we proceeded to level against the theory. In particular, it is hardly correct to say that the closest examination of meteoric stones has failed to reveal the presence of any substance indicating the pre-existence of life. A few such stones have been found to contain definite traces of carbon. Even the main item of our scientific objections to the theory must now be modified. It is not true that meteorites which survive the passage through the atmosphere are invariably white hot when they reach the earth's surface. On the contrary, they are hot only on the surface. The interior is still at or near the temperature of interplanetary space. With this change, the argument is, however, still applicable, for the excessively low temperature would be as destructive of life as the very high temperature which we postulated to exist. With the passage of years we have gained complete freedom for our speculations concerning the origin of life, but otherwise we are no nearer the solution of the problem than we were sixty years ago. There are, of course, those who reduce life to a mere constant of integration in a differential equation, and others who identify it with thought, and assert that its origin must for ever be unknowable by man. These views, however, do not seem to carry us very far. They do little else than make us sigh for the simplicity of the scientific outlook of sixty years ago.

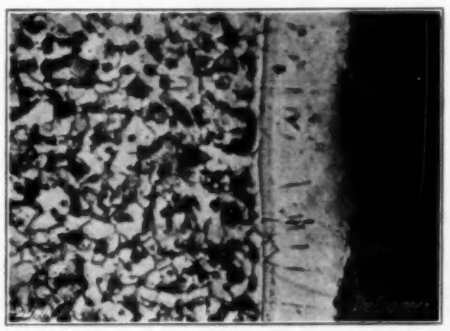
## Calorising.

THE process of calorising steel, for its protection against the effects of heat, which is carried out by the Calorizing Corporation of Great Britain, 32, Farringdon-street, London, E.C. 4, is effected by the conversion of the surface of the steel into an alloy of iron and aluminium. There then forms on the surface an extremely thin film of aluminium oxide, through exposure to the atmosphere. This film is impervious and, consequently, prevents further oxidation. It also has the merit that should it be accidentally abraded a new film immediately forms on the bare metal. As a consequence, the process forms an excellent protection against the scaling effect of high temperatures, in an oxidising atmosphere, on many engineering appliances, such as case-hardening pots, the supports for superheater elements, pyrometer casings, and so forth. Incidentally, it does not materially reduce the mechanical strength of the material treated.



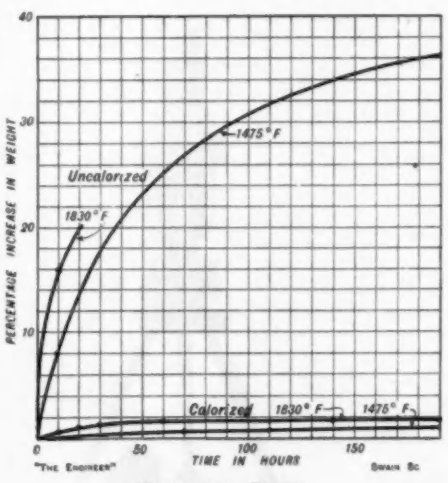
RETORTS FOR THE DRY PROCESS OF CALORISING

There are two methods of carrying out the process. In one the article to be treated is packed in a drum of granulated aluminium, while the drum is rotated to ensure intimate contact, and heat is supplied from the outside. In the other the articles are immersed in a bath of molten aluminium, and are kept there for a sufficient length of time for the penetration of the aluminium into the steel. In either case the result is much the same, but the shape and bulk of the articles determines which alternative shall be adopted. One of the photographs which we reproduce illustrates some of the retorts for the dry process of calorising which have been installed in the Lincoln works of the company.



SECTION OF CALORISED STEEL

The effect of the process is very well illustrated by the photo-micrograph we reproduce of a section of a piece of calorised steel. It will be seen that the normal structure of the steel merges, as the surface is approached, into an alloy with the aluminium, and that there is, finally, plain aluminium coated with the thin film of aluminium oxide, which produces the real protection.




OXIDATION TESTS

The resistance of the calorised steel, as compared with that of untreated metal to the scaling effect of high temperatures, is plainly shown in the graph, which we reproduce from the records of the research laboratory of the General Electric Company. It indicates the effects of the exposure of both plain and calorised steel to temperatures of 1475 deg. and 1830 deg. Fah. for periods of 180 hours and 20 hours respectively. It will be seen that the plain steel was practically entirely converted into oxide by the prolonged exposure, and then had virtually no mechanical strength, while the calorised metal took up oxygen to the extent of less than 2 per cent.

It might be thought that the effect of alloying the surface of the steel with aluminium would reduce the strength of the part treated, but that this is not materially the case may be gauged from the fact that in testing six specimens of calorised steel tube, 2in. in diameter, elastic limits of from 24,720 lb. to 29,660 lb. per square inch were found, while the ultimate strengths were of the order of 46,000 lb. per square inch. The elongations were such as one would expect in a mild steel.

The uses to which such a material may be put are numerous, but it should be pointed out that it must not be hammered or bent cold. It can, however, be worked at a bright red heat without damaging the alloy or affecting its resistance to oxidation.

## The Trans-Saharan Railway.

THE proposed transport arrangements across the Sahara Desert are represented by models and plans in the Colonial Museum at the Paris Colonial Exhibition where the competition between the motor car and the railway is emphasised by the importance of the interests behind them. The railway is backed up with the greater influence, since it was unanimously recommended by the commission of experts which surveyed the proposed routes, and it has a political importance which is held to justify a national sacrifice until the development of the African Colonies brings enough traffic to allow of an adequate return for the capital expended. It has, of course, a strategical value, but that alone would not warrant the carrying out of such a costly undertaking unless there was a certainty of its being made commercially successful. There are many who doubt whether the railway can become a commercial success. Passengers from Central Africa would have the option of travelling for more than 1000 miles over an intensely hot desert, unrelieved by anything to interest them, or of travelling by rail to the west coast and then by sea. They will also in the near future be able to travel by air. The extent to which goods will be carried across the desert must depend upon the cost. Notwithstanding the uncertainty existing about the economical aspect of the railway, it seems fairly certain that it will be constructed. No route has yet been definitely selected, but there does not appear to be any serious difficulty in the way, if shifting sands are avoided, and it is declared that the line can be laid rapidly over flat territory where stones can be riddled out of the sand for ballast.

At the Exhibition there is shown a small model of an oil-electric locomotive which will be built by the Compagnie des Forges et Acieries de la Marine et Homecourt of Saint-Chamond, with electrical equipment supplied by Als-Thom, as the Thomson-Houston and Société Alsacienne combination is known, and with Sulzer engines. The locomotive has four driving axles and two end bogies and two cabs for driving each way. There are two Sulzer engines, each of 750 horse-power, driving Als-Thom generators. The engines are placed side by side, with the generators at opposite ends. In the roofs of the cabs there are big horizontal ventilating fans. The locomotive is declared to be capable of hauling a 1500-ton goods train at a speed of 30 miles an hour and a passenger train at 50 miles an hour.

Some communication is already carried out across the desert by the Compagnie Générale Transsaharienne, which runs extensive services to the south of Algeria and Morocco, and claims to run vehicles to Gao on the Niger, though it is doubtful whether it does so regularly. So much travelling has been done across the desert by motor cars that the suitability of such vehicles for the purpose is fully recognised, but the question remains whether the services can attract passengers, and whether they can be made to pay. For the carriage of goods it is difficult to see how motor vehicles can compete with the railways to the west coast for shipment or even with the Trans-Saharan Railway. A model is exhibited of a Citroën car with Kégresse endless track, fitted with a 300 horse-power engine and hauling a passenger coach and goods van. It will travel 600 miles without taking in fuel. The models of Renault cars are of the six-wheeled type that has been used for desert service for some years past. It is, of course, probable that motor cars will be run across the desert when the routes selected have been organised. The success of the Trans-Saharan Railway, it is clear, depends upon many factors, though its supporters claim that it will create its own traffic by opening up the Niger Territory and Equatorial Africa.

# Geophysics.

No. II.*

## The Gravitational Method.

In our last issue the magnetic method of geophysical surveying was described. That method is rapid and comparatively cheap. Surveying by the gravitational method is slow and laborious in comparison and suffers from complications introduced by topographical features. But its theory is better understood, and it is not so limited in the number of materials that can be discovered by its use.

The history of gravitational surveying may be said to have begun when experiments were first made with pendulums and plumb-bobs. It was soon discovered that the period of oscillation of a pendulum was not constant, if it was moved about the surface of the earth, and from the alterations of the period some idea of the flattened shape of the globe could be deduced. Anomalies were also discovered where any large mass of particularly heavy or light material existed on or near the surface. The plumb-bob was used early in the attempt to discover the mean density of the earth, the attraction of a large mountain being measured by the deflection of the bob, and a comparison thus made between the estimated density of the mountain and that of the rest of the earth. It is probable that anomalies were also noticed with this instrument in the neighbourhood of large, heavy hidden bodies. The principle, however, of the instrument in use to-day was first enunciated by John Michell, who wished to measure the gravitational attractions between small bodies. For such a purpose instruments like the pendulum and plumb-bob were quite unsuitable, being insufficiently sensitive, and the apparatus he finally devised consisted of a bar from each end of which a 2in. lead sphere was suspended. The bar and its weights were hung within an enclosure by means of a fine wire, and arrangements were made for measuring any torsional deflection. Michell proposed to bring two other 8in. spheres close to the apparatus, one from each side, in such a way that they would conspire to rotate the beam in the same direction. After the beam had settled down the two heavy weights were to be moved across, so that they should conspire to reverse the rotation of the beam. Then the angle through which the beam rotated would be twice that through which it would rotate if the weights had been placed on one side only and then removed. Unfortunately, Michell died before he could complete the determination, and it was left to Cavendish to bring the experiment to a successful conclusion. It was subsequently repeated by C. V. Boys.

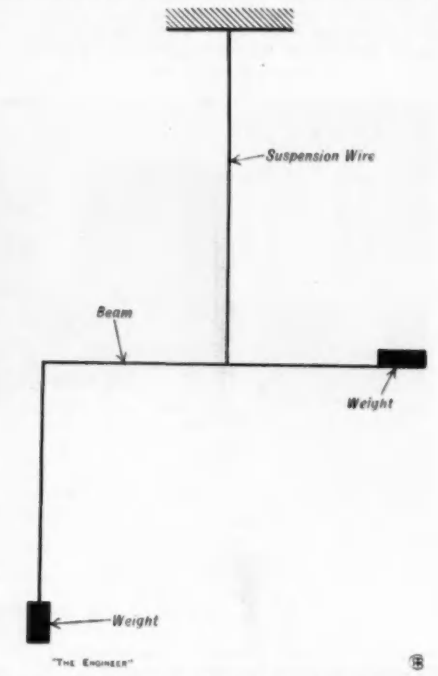



FIG. 9—DIAGRAM OF EOTVOS TORSION BALANCE

In 1888 Baron Roland von Eötvös, Professor of Physics at the University of Budapest, suggested that an apparatus similar to Michell's, but modified for the purpose, might be adapted for measuring very small changes in the local gravitational field of the earth. He constructed an instrument which, though strong and robust enough to be used in the field, was capable of measuring anomalies far smaller than those detectable by the pendulum. The sketch, Fig. 9, illustrates diagrammatically the arrangement of the instrument, which in essentials has not altered to this day. As in Michell's balance, a beam is suspended by a fine wire. A weight is fixed at one end of the beam and at the other—and this constitutes an important modification of the earlier apparatus—another weight is suspended below the beam by a thread. The two weights are equal, so that the beam is balanced. The effect upon this instrument when it is suspended in a gravitational field is that the lower weight being closer to the ground is attracted more strongly than the upper, so that the beam tends to rotate against the torsional resistance of the suspending wire, if there is any horizontal component of the force. The mathematics of the subject is too complex to be studied here, but it will be noticed at once that the absolute strength of gravity is not measured as it is with a pendulum. The instrument is only affected by alterations in the strength of gravity. Hence its sensitivity is superior to that of the pendulum.

The measure of the anomalous distribution of the gravitational field provided by the rotation of the beam may be divided into two parts. First, a beam weighted at each end like that in either the Michell or Eötvös instruments, and delicately supported in a gravitational field, will tend to rotate, the orientation at which it finally settles down depending entirely on the nature of the field. For instance, if the beam is placed above a valley running north and south, the gravitational attractions of the hills to the east

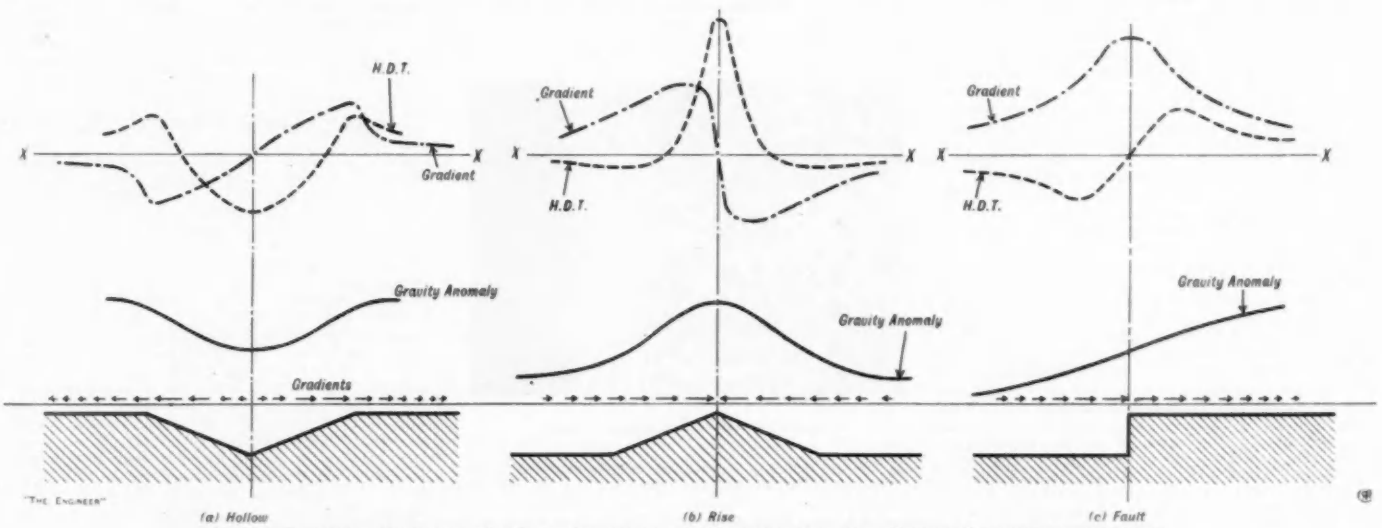



FIG. 10—DIAGRAM SHOWING RESULTS OBTAINED BY TORSION BALANCE ABOVE VARIOUS STRUCTURES

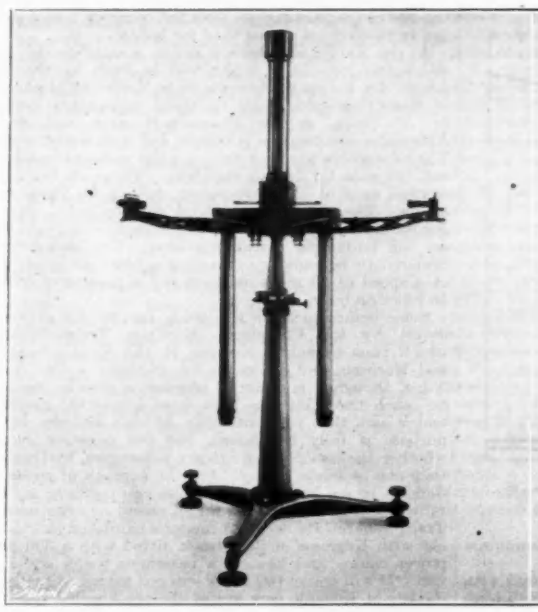


FIG. 11—SMALL ORIGINAL EOTVOS TORSION BALANCE —SUSS

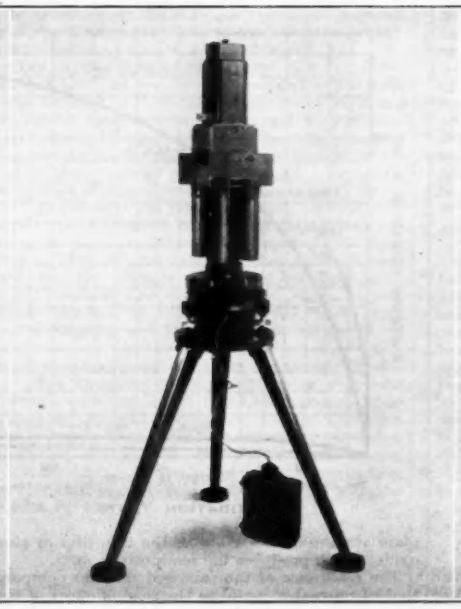


FIG. 12—EOTVOS-RYBAR TORSION BALANCE —SUSS

FIG. 13—EOTVOS-SCHWEYDAR TORSION BALANCE —ASKANIA

* No. I. appeared July 31st.

and west cause it to settle with its length across the valley. On the top of a north-south ridge, however, all the gravitational attraction lies to north and south of the instrument, so that the beam tends to swing with its length along the ridge. It must not be thought, however, that the beam is necessarily influenced by the shape of the ground surface. The actual forces acting upon it are caused by curvatures of the "level surface;" that is to say, an imaginary surface to which a plumb line is normal at each and every point. In the neighbourhood of a mountain the string of a plumb-bob is deflected from the line pointing towards the centre of the earth. But it remains at right angles to the level surface. Thus the level surface which can be thus described is curved into hills and valleys along or across which the beam tends to set itself. This effect is known as the Horizontal Directing Tendency, or H.D.T., and can be measured with both Eötvös and Michell instruments. But owing to the fact that in the former apparatus one weight is suspended at a lower level than the other, it is affected also by the gradient of gravity. If the Michell instrument was placed in a gravitational field that was increasing in strength uniformly in one direction, it would have no tendency to rotate, since the forces acting on the two weights would be exactly equal, both in direction and intensity. But in the Eötvös instrument the two weights, being at different levels above the surface, the attractions upon them differ slightly in both direction and intensity, so that a force trying to rotate the beam exists.

From the above considerations it will be seen that the position that the beam of an Eötvös torsion balance finally assumes depends upon

(*a*) The constants of the instrument, which includes the torsion coefficient of the suspending wire;

(*b*) the magnitude of the Horizontal Directing Tendency;

(*c*) the position of the principal axes of curvature—in other words, the lines of the "hills and valleys" in the gravitational field;

(*d*) the magnitude of the gradient of gravity or the rate of change of gravity;

(*e*) the axes of maximum and minimum gradient.

(*a*) is, of course, a known quantity, but the other four are unknowns, so that five readings of the instrument must be taken at each station, the beam being swung into a different azimuth for each. Actually, it is usual in the field to take six readings, the last one acting as a check.

In Fig. 10 sketches are given to show the type of result that is to be expected over three different geological structures. That part at the bottom of each diagram which is shaded represents a dense rock heavier than the earth lying below the surface, which is represented by the straight line above. In Fig. 10 (*a*) there is a depression in the surface of the heavy rock. Owing to the reduced weight immediately above this point, the value of the attraction of gravity will decrease immediately above it and, in consequence, the curve showing the anomaly will be like that shown in the lower of the three curves. The gradients of gravity are shown in two ways. In the graph above with base X X the gradient is shown as negative when gravity grows stronger from right to left, and positive when it is increasing towards the right. This curve obviously follows from the anomaly curve. Immediately above the line representing the ground surface the gradients are represented in another way. Arrows are drawn with their heads towards the direction in which gravity increases, the length of the arrow indicating to scale the steepness of the gradient. This method of representation is used when drawing a map of the survey. The third curve shows the intensity and direction of the Horizontal Directing Tendency. The H.D.T. is shown as positive when the beam has a tendency to set itself with its length at right angles to the plane of the paper, and as negative when the length of the beam would be in the plane of the paper. It will be seen that over the centre of the depression the H.D.T. makes a strong effort to put he beam into the plane of the paper. Here there is the equivalent of a valley. At the edges of the depression, however, the H.D.T. tries to place the beam at right angles to the paper. Here there is the equivalent of a ridge. In Fig. 10 (*b*), similar curves for a raised portion of the heavy rock are given. Here the H.D.T. becomes negative on each side owing to the valley-like form. In the third set, Fig. 10 (*c*), a fault is represented. An interesting point to be noticed in these curves is the way in which the H.D.T., plotted in this way, follows out the form of the heavy rock.

Of course, in the field and surveying over actual geological structures instead of their mathematical representations, the curves become more complicated. Actually, the geophysicist calculates from his results the possible mathematical geological structures compatible with the readings of his instruments, and the geologist and geophysicist must then translate the mathematical structures into the geological.

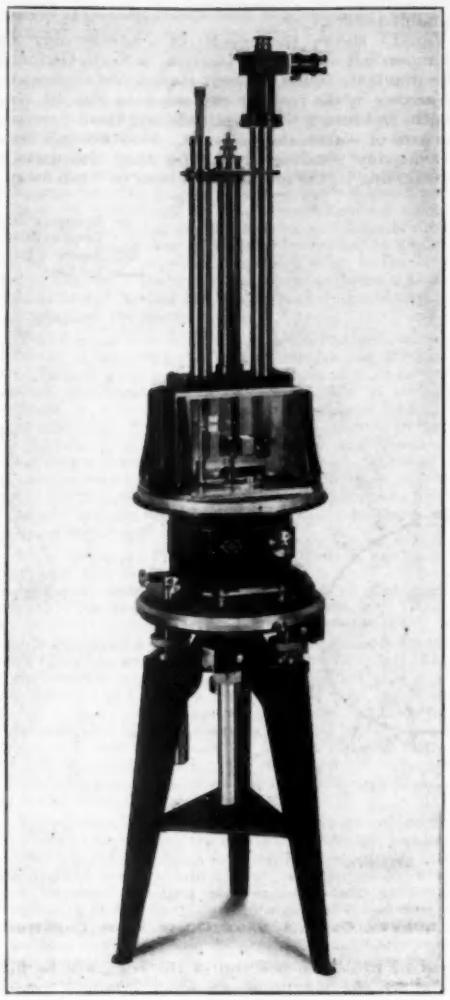


FIG. 14—GRAVITY GRADIOMETER—CAMBRIDGE

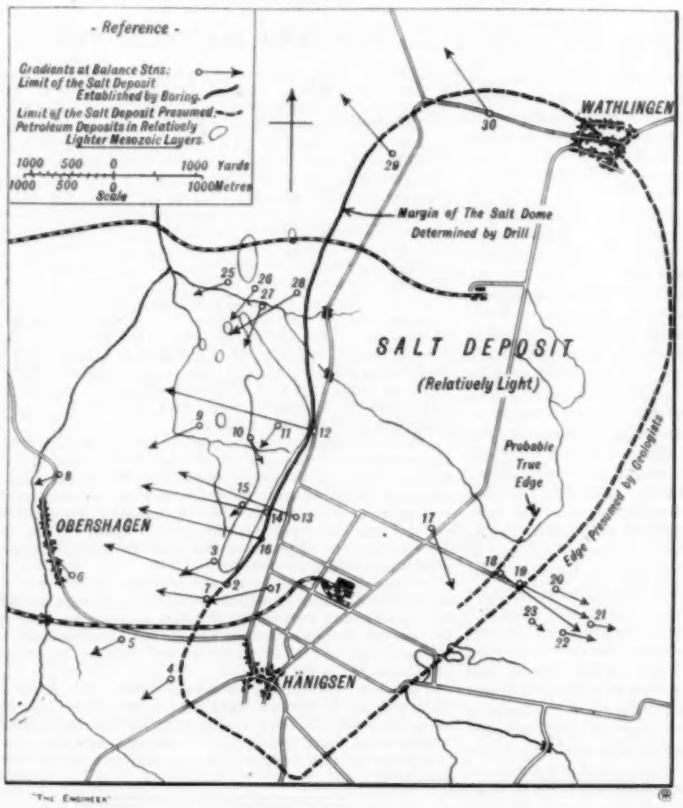



FIG. 15—RESULTS OF A GRAVITATIONAL SURVEY AT HANIGSEN, GERMANY

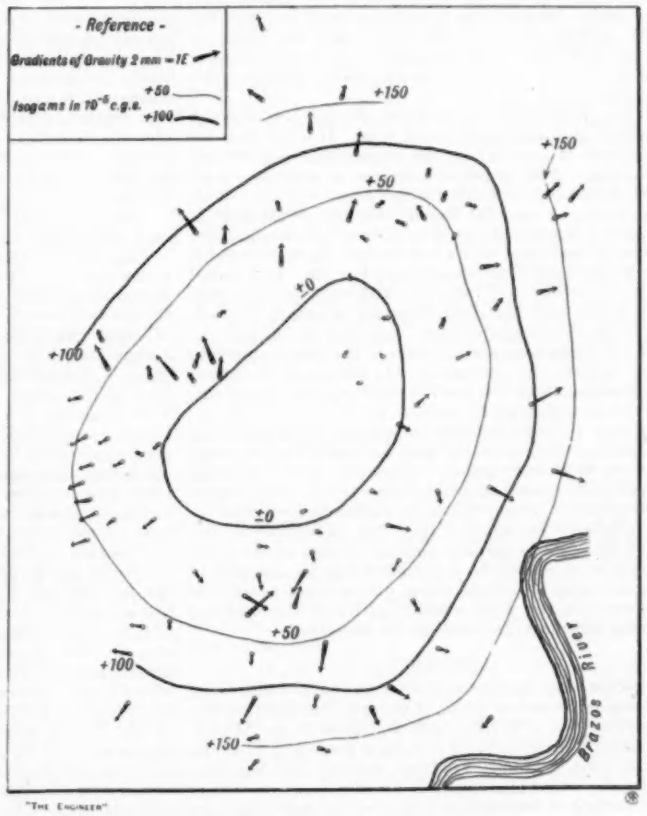



FIG. 16—GRAVITY SURVEY OVER A SALT DOME IN TEXAS

### INSTRUMENTS.

In the photographs reproduced in Figs. 11 and 12 two torsion balances, made by Ferdinand Süss, of Budapest, are illustrated. This firm was responsible for making the first torsion balance to the order of Baron Roland von Eötvös. That shown in Fig. 11 is known as the small original Eötvös torsion balance. Owing to the fact that the beam of a torsion balance takes a considerable time to settle down—in the earlier instruments as long as two hours—any means by which the rapidity with which readings are taken can be increased is adopted where possible. Most modern instruments, like this one, are, therefore, fitted with two beams and two suspension wires. Two sets of readings can then be taken in each azimuth and the number of azimuths in which the instrument must be set is reduced from five to three. The instrument illustrated in Fig. 11 has torsion wires 300 mm. long with a diameter of 0·02 mm., and the two beams are each 100 mm. long. By incorporating suitable damping arrangements the makers claim to have reduced the time between successive readings to 45 minutes. The suspended weights are contained in the two pendant tubes, and the optical system for measuring the deflection, which is, of course, very small indeed, is supported on the cross beam. For purposes of transport the beams and the hanging weights can be clamped up so that jolts and shakes shall cause no damage, while the whole suspension system is protected in a box and tubes from variations in temperature or other outside influences. The apparatus complete with tripod weighs 38 kilos.

The other instrument—see Fig. 12—is known as the Eötvös-Rybar torsion balance, and is fitted with an automatic photographic registering device,

which records photographically the reading of the beam and turns it into another azimuth between readings. The time occupied by the beam in coming to rest is given as 40 minutes, the torsion wires are 200 mm. long, and 0·01 mm. in diameter, the length of the beam 70 mm. and the total weight of the apparatus, including the tripod, 35 kilos.

The illustration, Fig. 13, is a reproduction of a photograph of a small Eötvös-Schweydar torsion balance made by Askania-Werke A.G., of Berlin Friedenau. In order to reduce the height above the ground at which this instrument must be mounted, each beam is of Z formation, the weight at one end being mounted above the beam on a rod and the weight at the other supported below it by another. Special arrangements are made for setting up the instrument at each station, and the foot and base-plate are so made that the centre of gravity of the suspended system may be placed at three different heights above the ground. If the instrument is set high the influence of the immediate surroundings is reduced, and the makers claim that by taking readings at each of the three levels the effects of purely local disturbances can be computed and allowed for. The torsion wires of the instrument are 280 mm. long, with a diameter of 0·036 mm., and are made of platinum iridium. The weights are each 22 grammes. Arrangements are made for automatic photographic recording.

The photograph reproduced in Fig. 14 shows a balance of rather a different type. It is the Gravity Gradiometer, made by the Cambridge Instrument Company. The suspension system consists of a wire with a torsion coefficient of less than 0·1 c.g.s. unit, supporting a circular beam carrying a number of weights; a vertical rod, 45 cm. long, is also mounted upon it, carrying at its upper end another weight. Such a system is unaffected by the Horizontal Directing Tendency, so that, although there is only one beam, only three readings are necessary to complete an observation, since only two unknowns are left—the gradient and its axes. The beam comes to rest under the influence of dampers in about 20 minutes, and the total weight of the instrument, complete with tripod, is about 100 lb.

Every form of instrument is fitted with scales for obtaining the azimuth and an accurate levelling device, while the optical systems that must measure small deflections accurately have to be very refined and perfect. Since the instruments are affected by atmospheric conditions, they are protected in the field by tents or some other convenient covering, in one type of which the instrument can be clamped to the hut and the whole thing placed on a truck and wheeled to the next station without the need for taking down and re-erecting the covering.

### Surveys.

Before any readings can be taken a number of corrections must be made. Owing to the fact that the earth is not a perfect sphere, there is an H.D.T. pulling the beam into an east-west position and at the same time a gravity gradient towards the Equator. This correction is a constant for any small portion of the surface of the earth and depends upon the latitude. Of far greater effect is the local topography, and an accurate survey of the levels of the ground around the instrument must be carried out at every station and allowances made for the varying contours. It is obvious that if the topography is very involved, calculations of the allowances to be made for it become very complicated and uncertain. In consequence the instruments can only be used in comparatively flat country. Atmospheric conditions also have a rather incalculable effect. Nevertheless, given suitable surroundings the gravitational method can produce valuable results.

Fig. 15 shows the results of a survey over the Hänigsen salt dome near Hanover, in North Germany. The gradients found at each station are represented by arrows in the manner explained in Fig. 10, their lengths indicating the magnitude and their directions the axes of maximum gradients. Since the salt dome is relatively considerably lighter than the material surrounding it, the gradients all tend to "run away" from it, while the position of the edge will be indicated by the maximum gradient. On the western side the margin of the salt dome had already been determined by geologists by means of borings, but on the east it had only been estimated. In 1917 Professor Schweydar conducted a gravitational survey over the area. The gradients found on the west confirmed the conclusions of the geologists; it will be noticed that the greatest gradients occur along the line of the margin of the dome, but in the east the largest gradients were found some distance to the west of the margin presumed by the geologists, and it appears probable that the true edge lies further back. Professor Schweydar was able to conclude from his observations that the top of the deposit was inclined, the western edge being nearer the surface than the eastern, that the sides fell away steeply and that the western edge was overhung, all of which conclusions are said to have been subsequently established by borings.

Figs. 16 and 17 show the results of two gravimetric surveys over salt domes in Texas. That shown in Fig. 16 is similar in some respects to the Hänigsen Dome survey. The salt is relatively lighter than its surroundings and the gradients all point outwards. In addition to the gradient arrows, isogams or lines of equal gravitational anomaly have been drawn. Judging from the gradients shown, the margin of the dome is approximately outlined by the +100 isogam upon which most of the gradients are a maximum. This dome lies at a depth of 4200ft. below the surface, and in consequence it is not surprising that some of the gradients appear to have been affected by smaller local anomalies. Large gradients in mutually opposing direc tions are to be seen in some places. The survey shown in Fig. 17 should be compared with the last. In this case the salt dome lies at a depth of 400–500ft. below the surface and is covered by a thick cap rock of anhydrite and gypsum. The cap rock is heavier than the surrounding material, while the salt is lighter; but since the cap rock is nearer the surface than the salt, its effect is the greater upon instruments erected near it, and in consequence near the dome all the gradients run inwards. Further out, however, the effect of the light salt dome is felt and the gradients are reversed in direction. In this survey readings of the H.D.T. were also taken and plotted and are represented on the map by straight lines through the various survey stations, the length and direction of which give the strength and orientation of the H.D.T. respectively. The largest gradients occur in the positions marked by the black line, and this will be the edge of the cap rock. A map of the isogams is also included from which it can be seen that the black line does follow the maximum gradients. It is instructive also to compare the direction of the H.D.T. lines with the isogams and to note that they tend to point towards the deposit for some distance outside its margin, but that inside they tend to lie parallel to the margin. This change of direction is to be expected, as the position is similar to that of crossing a fault. If reference be made to Fig. 10 it will be seen that in that case the H.D.T. changes direction. Further out, where the gradients are running away from the dome, the H.D.T. lines are again nearly parallel to the edge of the dome.

A salt dome is a formation particularly suitable for gravity survey, but use can be made of the method for many other formations. A survey was conducted with torsion balances over the Swynnerton Dyke, the magnetic survey of which was described in our last issue and gave results similar to those obtained with the variometer. Its chief disadvantages are the length of time which it takes to obtain a set of readings and the great influence of topographical features. But its theory is better understood than that of the variometer and its advocates claim that the results obtained are more reliable.

*(To be continued.)*

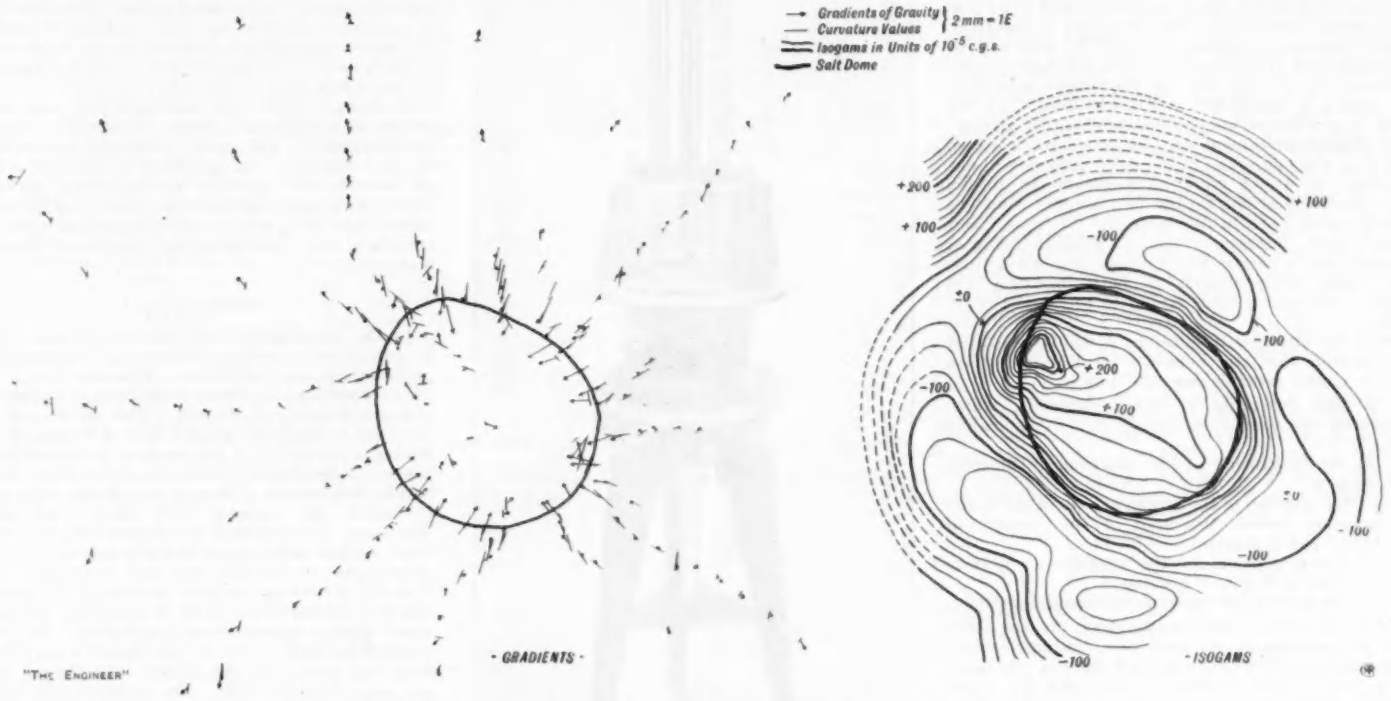



Fig. 17—Gravity Survey Over a Salt Dome with Cap-Rock of Anhydrite

## A NOTABLE ELECTRICAL TEST.

A test recently made on a three-phase turbo-alternator in the Metropolitan-Vickers works at Trafford Park, Manchester, is believed to constitute a world's record. It involved running the machine, which is designed to give 11,000 volts at 1500 r.p.m., on a wattless load of 72,000 kVA, the duration of the test being six hours. The test was made on the company's test bed for the purpose of confirming calculations and obtaining data for further design. The energy generated during a test under normal full-load conditions would have represented a sum of over £1000, but by loading the alternator with wattless current at full voltage, full load conditions were obtained at a total cost for energy of under £50. This result was secured by using apparatus constructed by the company for the special purpose of making tests on turbo-alternators. The apparatus consists of two 22,000-kVA reactors, each weighing 45 tons, and in making the test under consideration both of these reactors were employed, together with two motor generator sets of 10,000 kVA and 6000 kVA respectively, and also with a second generator of 15,000-kW capacity.

Other tests made with the turbo-alternator while erected on the test bed consisted of an important series of short-circuit trials on oil circuit breakers. By connecting the machine in either star or delta and by utilising special timing arrangements, the circuit breakers opened within one to two half cycles after the initiation of the short circuit, and currents up to the value of 100,000 amp`res were successfully interrupted.

All the data needed were recorded by means of a nine-element oscillograph, which produces oscillograms showing current and voltage in all three phases, together with arc energy, pressure rise in the circuit breaker tank, and the complete travel of the cross bar, during the clearing of the short circuit.

The test conditions obtained with the apparatus approach actual service conditions very closely, and these tests, together with many others, made during a period of years, have furnished data of inestimable value to the company in the design and manufacture of its circuit breakers.

The statistics of the Board of Trade show that if the amount of electricity generated by authorised undertakers in Great Britain during 1924 is taken as unity, the production in 1929 had increased to 1·69 and last year was 1·79. During the same period the building of dwelling-houses increased in the ratio of 1 : 1·175 : 1·242.

## Railway and Road Matters.

THE chairman of the International Sleeping Car Share Trust said recently that the Wagon Lits Company had had to spend a large sum in replacing its cars, owing to a preference on the Continent for steel as opposed to wooden cars.

WE learn with great pleasure that Mr. J. L. Thomson, B.Sc. (Hons.), the science master at the Horwich Railway Mechanics' Institute Technical College and Junior Technical School, has won one of the two Whitworth Senior Scholarships.

THE London and North-Eastern has lost a very useful director by the death on July 27th of Colonel C. W. Trotter. That gentleman, because of his financial interests, was connected with the Hull and Barnsley, and became a director of the North-Eastern when it absorbed the smaller line, and of the L. and N.E.R. on its formation at the end of 1922.

THE meeting between the Minister of Transport and the railway companies, which we mentioned on July 31st, for the purpose of discussing the Weir report on electrification, duly took place on Friday last, the 31st ult. The meeting lasted several hours, and at the close it was officially stated that the various aspects of the matter were discussed and would be further explored, and that in the meantime no further statement could be made. We presume that the latter remark applies to the letter from the companies to the Minister, of which Mr. Morrison said, in the debate on July 23rd, that, whilst not terribly afraid of it, he would not publish it until he had discussed the question of publication with the companies.

THE Great Western interim dividend on its ordinary stock is at the rate of 1¼ per cent., as compared with 2¼ per cent. for the first half of 1930. It is the only one of the three "heavy" companies to pay an interim dividend on its ordinary stock. The gross receipts fell by £1,777,000, but economies were effected to the extent of £815,000. The London, Midland and Scottish had a drop of £3,000,000 in traffic receipts, and losses from "other businesses" brought the decrease up to £3,400,000. Independently of the increase of £400,000 in expenditure, due to the non-operation in 1931 of the 2½ per cent. deduction in salaries and wages, there was a reduction of £2,000,000 in the expenditure. The loss on the half-year was thus £1,400,000, and, in contrast to the 1 per cent. paid a year ago, there will be no interim dividend on the ordinary stock. Compared with the first half of 1927 the expenditure was £5,000,000 less.

THE recent trouble in the House of Lords over the proposed site for the station at Camberwell Green in connection with the "Underground" Company's extension from Elephant and Castle has revealed a weakness in the submission of parliamentary notices. The site selected was on Camberwell Green, which, whilst an open space, was not, however, commonable land, and so it was not necessary for the public notices in the newspapers specifically to mention the fact. The Camberwell Borough Council made a bargain with the promoters whereby the latter, in consideration of spending £6000 upon the improvement of St. Giles' Churchyard, could have the use of that portion of the Green which they required. Neither party in that respect acted *ultra vires*. The London County Council, further, had a copy of the plan. Lord Onslow, Chairman of Committees in the House of Lords, in pointing this fact out on July 21st said that he did not think that blame could be attached to any of the parties concerned, but thought that the standing orders should be strengthened to meet such cases. His lordship brought forward certain suitable amendments on July 27th, which were agreed to.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first six months of the present year was as follows, the corresponding figures for 1930 and 1929 are added in brackets:—Locomotives, £1,000,297 • (£1,954,582, £1,544,778); rails, £532,570 (£1,264,755, £1,435,610): carriages, £793,609 (£836,313, £1,014,162); wagons, £713,467 (£1,664,857, £1,281,412); wheels and axles, £114,886 (£166,899, £203,235); tires and axles, £173,940 (£367,600, £268,969); chairs and metal sleepers, £207,311 (£426,438, £237,131); miscellaneous permanent way, £1,607,499 (£1,514,046, £1,359,521; total permanent way, £1,293,349 (£2,752,180, £2,773,628). The weight of the rails exported was 63,624 tons (143,522 tons, 171,917 tons) and of the chairs and metal sleepers 28,075 tons (46,068 tons, 23,625 tons). During the month of June last locomotives to the value of £130,239 were shipped overseas, which included £25,989 for the Argentine and £13,487 for the Straits Settlements. The value of the rails shipped during the same month was £43,718 and included British West Africa £29,701, the Argentine £3262, India £3136, South Africa £2900, and New Zealand £1048.

IT was fifty years on August 5th since a serious accident occurred at Blackburn on the Lancashire and Yorkshire Railway, wherein seven passengers were killed. The accident attracted considerable attention in railway circles because it was alleged that it was caused by a failure of the Westinghouse brake; the reason for the unusual interest being that the question of the provision of continuous brakes for passenger trains was then very much in evidence. On the afternoon in question a passenger train was standing in Blackburn Station, and the signals were therefore against an express from Manchester. The driver of the express, however, overran the signals and collided with the standing train. The lay-out of the station at that date was very antiquated, and the signalling arrangements were in keeping with those conditions, and one claim put forward as to the cause of the collision was that, owing to inadequate signalling, the driver did not get sufficient warning. It was, however, asserted, on the other hand, that the Westinghouse brake failed. The accident was inquired into by Colonel Yolland, who reported that he had come to the conclusion that it was caused by the failure of the automatic brake to act properly when approching Blackburn Station. That there was ground also for the alternative suggestion as to the insufficiency of the warning given to the driver is suggested by Colonel Yolland's further remark that the collision would probably not have occurred had the absolute block system been in operation.

## Notes and Memoranda.

PRIOR to 1923 the levelling rods used by the Geodetic Survey of Canada, Department of the Interior, were made of wood, specially impregnated with paraffin, and were standardised before and after each field season. However, since 1923 a strip of invar—an alloy of nickel and steel, unaffected by climatic conditions—is attached to the face of a supporting wooden rod. The use of the invar rod has removed the necessity for rod corrections which formerly caused great delay.

A CAREFUL study of the drying rate of white pine conducted by the Canadian Forest Products Laboratories, Department of the Interior, disclosed the fact that a normal pile of 1in. lumber will dry from green to air-dry condition in about six weeks under summer conditions such as existed in the summer of 1930. Lumber in the top zones of the pile dries much more quickly than in the bottom zones, the lag in the latter case being sometimes as much as four weeks behind the top. The side zones dry more quickly than the middle zone.

THE Purdue University in America has devised a new method of socketting stranded wire cables for testing purposes, in which the wires of the cable are not subjected to any abnormal conditions. The cable is served to prevent it unwinding and then the ends are opened out and bent over. The end of the cable is inserted in a short length of steel pipe with a tapered end, and the crevices filled with a quick-setting alumina cement. It is said that within twenty-four hours the full strength of the rope could be determined, and it is obvious that the scheme does not involve any temperature effects on the wire, as does setting in molten white metal.

IN a note in the *Drop Forger*, Mr. Bowers, an American engineer, who is now building a forge shop in Russia, gives some impressions of existing shops in that country. He says, for instance, that a useful criticism is provided by bulletin boards placed at intervals throughout the shop, on which are hung scrap forgings bearing tickets explaining who made the scrap and how it was made. Mr. Bowers considers this type of criticism very effective, and none of the workers cares to see his work put "on the board." Another method was observed on a large bulldozer which was standing idle and bore a placard which, roughly translated, read as follows: "I sleep because Comrade So-and-So forgot to oil me," or whatever the cause of the breakdown was. It is noteworthy that he says that most of the workers are unskilled.

AN outcome of the recent international gathering of chemists in London for the Society of Chemical Industry's jubilee has been a scheme for co-operation between manufacturers of Great Britain, France, and Germany. French and German scientists and industrialists visited the Exhibition of British Chemical Plant, and it has been provisionally agreed that future exhibitions of this nature in the three countries shall be organised and advertised in close collaboration. Each country will take its turn triennially. France will hold her next exhibition in 1932, Germany will follow with "Achema" in 1933, and the exhibition will again be held in Britain in 1934. The representative organisation in each country dealing with the manufacture of chemical plant will be responsible for organising parties to visit the exhibitions held in the other countries.

THIS is not quite engineering, but it is closely related thereto. It comes from the report on the competition of industrial designs of the Royal Society of Arts:—Bagues, Ltd., offered a prize for a design for a decorative ceiling light or laylight in wrought iron and glass for the roof of a palm court adjoining a fashionable restaurant. The judges were unable to recommend that the full amount of the prizes offered should be given, but they made some awards. The judges regret to have to record their opinion that the entries were of a low standard, and that none of the competitors showed talent. Here was a problem of considerable interest and importance, the correct solution of which could have had an important bearing upon hotel and restaurant treatment generally. Competitors were asked to submit designs for a laylight for a high-class restaurant. It is safe to say of the majority of the designs that, if they were adopted, the restaurant would, for this very reason, cease to be fashionable. Four of the thirteen competitors seem to consider that a green light is one which would please the ladies. Corpse-like pallor, however, is not the vogue. The two designs which were awarded prizes showed some appreciation of the requirements, but in the case of one the central detail was bad, and in the other case it was uninteresting and "greenhousy." Both these competitors acknowledged the hint given that coloured glass might contribute to the decorative effect, but their rendering was ineffectual.

A REPORT, entitled the Physical and Chemical Survey of the National Coal Resources, No. 18, just published by H.M. Stationery Office, price 2s., deals with the Barnsley Seam, which yields over 50 per cent. of the total output of coal in the South Yorkshire area. It gives the results of a comprehensive and detailed examination, from floor to roof, of sixteen complete sections of the seam taken at points well distributed over the area. Each section was divided into sub-sections, the number of which depended largely upon the number of different types of coal visible, and samples representing the average composition of each sub-section and of the whole seam section were prepared for analysis. Proximate and ultimate analyses, and determinations of the calorific values and amounts of soluble and total chlorides have been carried out upon each of these samples; their behaviour on carbonisation in the Gray-King assay apparatus has also been studied. The fusion points of the coal ash from samples of the total "hards" and of the whole seam have been determined, both in an oxidising and in a mildly reducing atmosphere. In addition, samples of the four banded constituents—vitrain, clarain, durain, and fusain—have been picked by hand from each section and submitted to proximate and ultimate analysis. An appendix deals with general considerations of the uses of Barnsley coal for various purposes, and the report includes a map of the South Yorkshire area, diagrams of the sections of the seam obtained for this investigation, and photographs of typical cokes from the Gray-King carbonisation assay.

## Miscellanea.

THE rolling mills at London, Ontario, are to be reorganised for the production of alloy steels.

Two types of motor lorries are to be made in China at the Liaoning Arsenal, and are to be marketed at prices of 1070 dollars and 2000 dollars, gold, respectively.

THE Canadian Pacific Railway is using 200 barrels of crude oil, taken from the Ribstone wells, a day in its locomotives on the mountain division between Calgary and Field.

THE total number of commercial vessels which passed through the Panama Canal during the year which ended on June 30th was 5529. The average number of passages was 15·15 a day.

WORK is progressing favourably on the 275,000 horse-power Abitibi hydro-electric power scheme in Ontario. The entire flow of the river is now being carried in two tunnels round the site, which has been unwatered.

THE first section of the Slave Falls power station, Manitoba, is to be opened on September 1st. It comprises two units of 12,000 horse-power each. The ultimate capacity will be 96,000 horse-power. The current will be transmitted to Winnipeg by a line 86 miles in length.

THE Swiss Post Office has introduced handcarts made of steel tubing with aluminium panels, and has thereby reduced their weight from 60 kilos. and 150 kilos., which was the case with the wooden carts, to 40 kilos. and 80 kilos. They have been equipped with pneumatic tires.

THE new plant of the North-West Stellarene Company at Coutts is now operating and constitutes Alberta's first "vapour-phase cracking" petroleum refinery. The company's product is an anti-knock gasoline known as Stellarene and is manufactured by an adaptation of the Leamon process.

AT Akron, Ohio, there has been put in service a portable mooring mast for dirigible airships. It is a triangular pyramid, 76ft. high, with a base set on a 125ft. circle. It weighs 125 tons, and is carried on caterpillar tracks that are driven by a petrol engine. The same engine is used for hauling in the mooring rope.

A METHOD of tunnelling in strong rock, which does not need timbering, has been patented in America by H. H. Fisher, of Chicago. The broad principle of the idea is to blast away an overhanging sloping roof, and allow the *débris* to fall directly into a conveyor skip below. The scheme is described in the *Engineering News-Record* of July 23rd.

THE central feature of Liverpool's Shipping Week, which is to be held from August 29th to September 5th, will be an exhibition showing the evolution of the port from its earliest days down to the present time. The progress of shipping will be illustrated by models from the war canoe up to the H.M.S. "Hood" and the latest ocean greyhounds.

THE latest census report compiled by the local Chinese Municipal Bureau of Public Safety shows that the foreign population residing in Hankow totals 2766, of whom 2481 are Japanese. The other 285 foreigners consist of English, French, Germans, Russians and Americans. The Japanese population is thus nearly nine times the number of the other foreign groups.

AT the close of 1930, states the annual report of the Federated Malay States Mines Department, there were 69 bucket dredges in operation and 13 under construction, as compared with 105 dredges in operation and 10 under construction in the previous year. The allocation of the active dredges was as follows:—Perak, 66; Selangor, 32; Negri Sembilan, 8; and Pahang, 1.

THE ships making their first passage through the Suez Canal during last year numbered 249, the same as the year before. Their tonnage, however, decreased slightly, from 1,075,000 tons to 1,043,000 tons. There was a considerable decrease in the proportion of British and American tonnage and a very marked increase in that of Holland. The Italian quota was very little changed.

AN important development, a direct result of drilling operations in the Ribstone area, of Alberta, is forecasted by R. L. Cook, drilling superintendent of Ribstone Oils, who stated that a 25,000 dollars evaporation plant for the production of calcium chloride will likely be erected at Rivercourse, provided that a daily supply of 25 tons of calcium chloride can be assured. Of the required amount, tests show that Ribstone No. 2 well can supply 13 tons daily, and Reyco No. 1 well, now being drilled, is expected to strike water, sufficiently high in calcium chloride, to supply the balance.

THE Canadian National Development Bureau (Department of the Interior) at Ottawa, in co-operation with the Canadian Department of Trade and Commerce, has prepared a compilation of data entitled "The Canadian Industrial Field," which is intended for the guidance of British and foreign industrialists considering expansion in Canada. The publication can be consulted in Great Britain at Canada House, Trafalgar-square, London, S.W. 1, as well as at the offices of the various Canadian Government Trade Commissioners at Bristol, Glasgow, Liverpool, Belfast, and Dublin. The volume, which is illustrated by a number of economic maps, consists of twelve chapters.

A WIRELESS beacon station which enables ships' pilots to take their bearings with a stop watch is to be erected by the Marconi Company at Rangoon as a special aid to navigation in the busy shipping channel of the principal port of Burma. This type of wireless beacon has a vertical loop aerial which revolves at a steady speed, making one complete revolution in sixty seconds and emitting a well-defined beam of wireless waves in its own plane as it turns. When the plane of the loops points to the north, and again when it points to the east, a distinctive signal is sounded, while at other times a steady dash is emitted. By observing with a stop watch the time taken between hearing the north or east signal and the moment when the steady signal reaches minimum—through the revolution of the aerial—the navigator of a ship can calculate exactly the direction in which the wireless beacon lies.

# THE GRAMPIAN HYDRO-ELECTRIC POWER SCHEME

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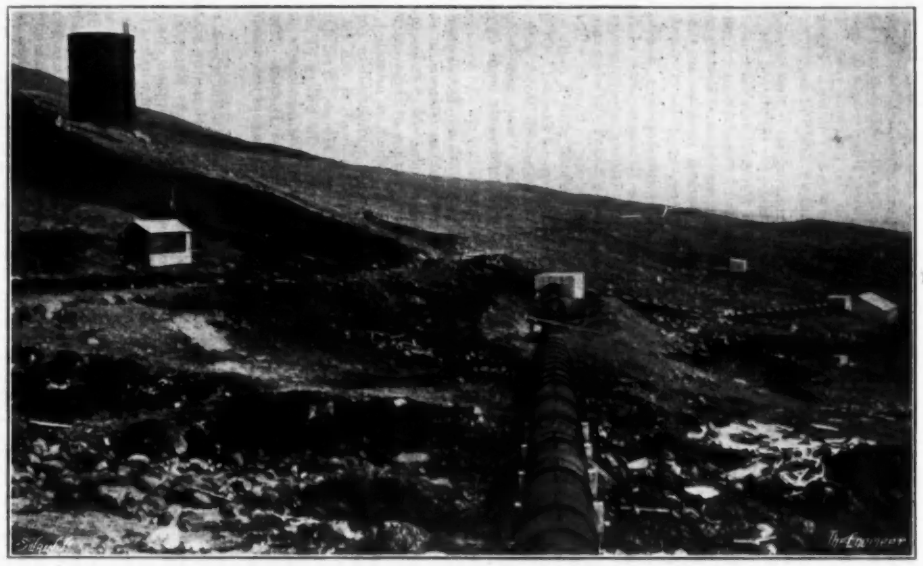
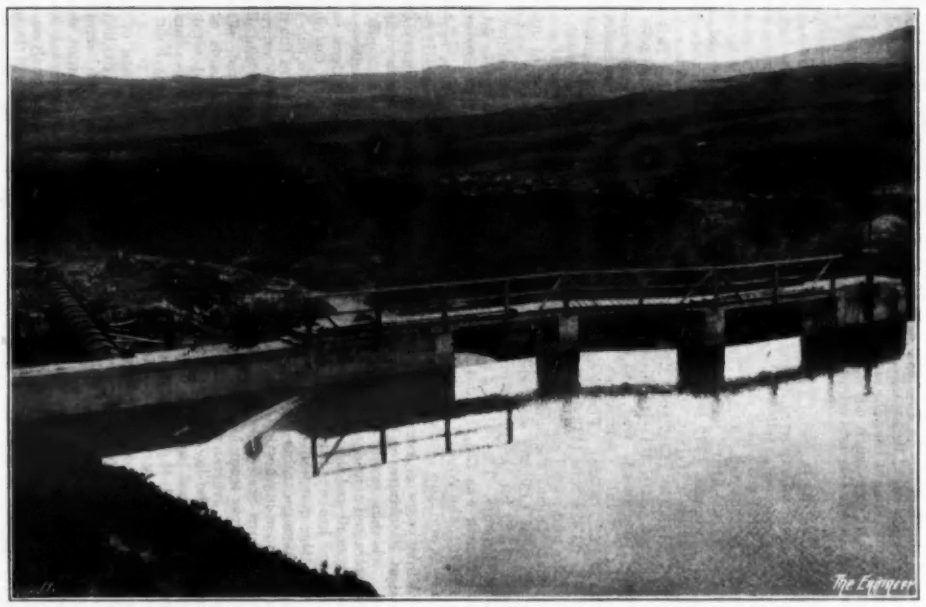
(*For description see page* 148)



PIPE LINE AND SURGE SHAFT FOR TEMPORARY POWER-HOUSE

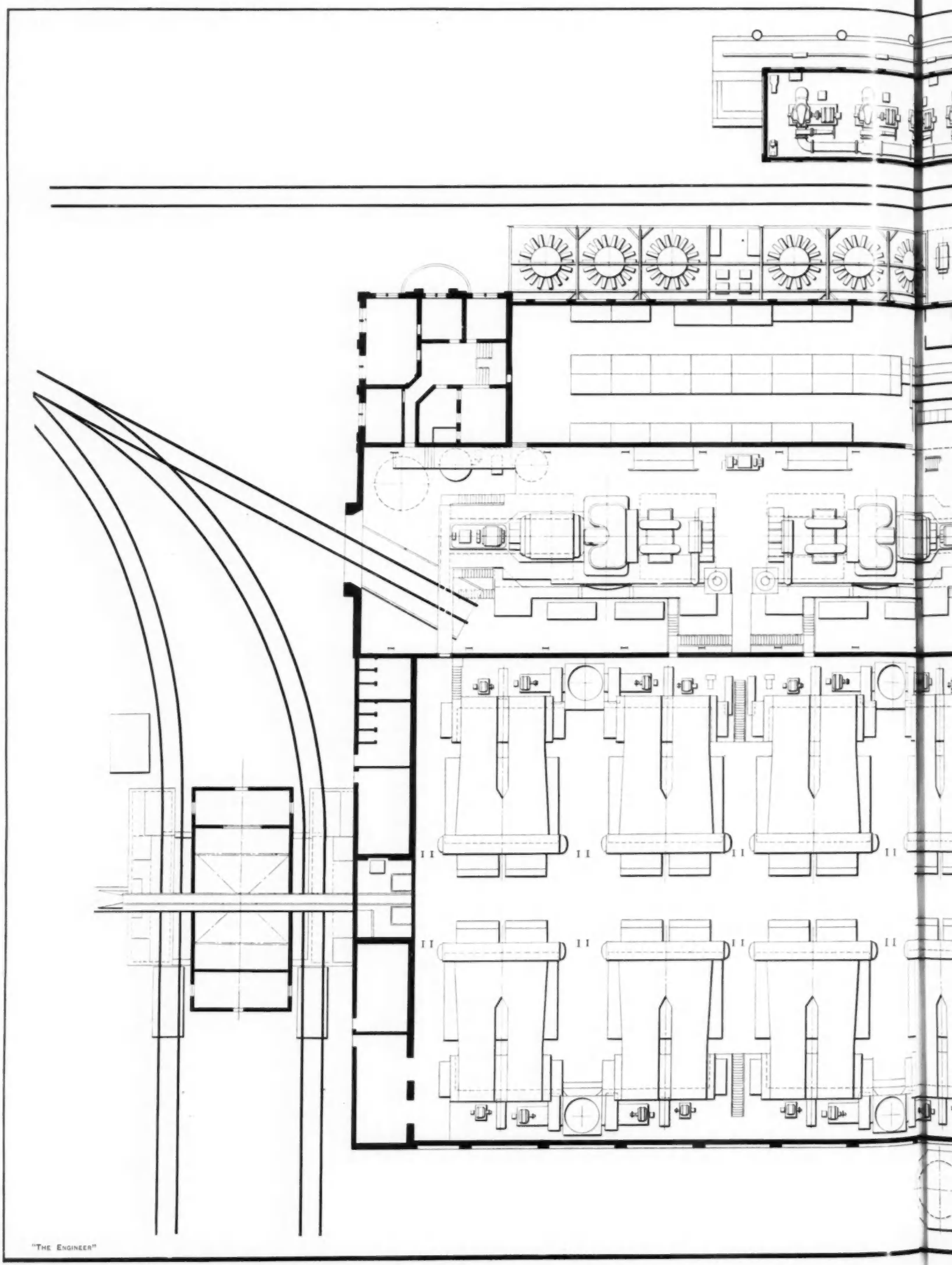
TEMPORARY POWER-HOUSE, PIPE LINE AND SURGE SHAFT



LOOKING DOWNSTREAM FROM RESERVOIR FOR TEMPORARY POWER-HOUSE

DOWNSTREAM FACE OF DAM FOR TEMPORARY POWER-HOUSE

# KEARSLEY POWER STATION—LANCASHI



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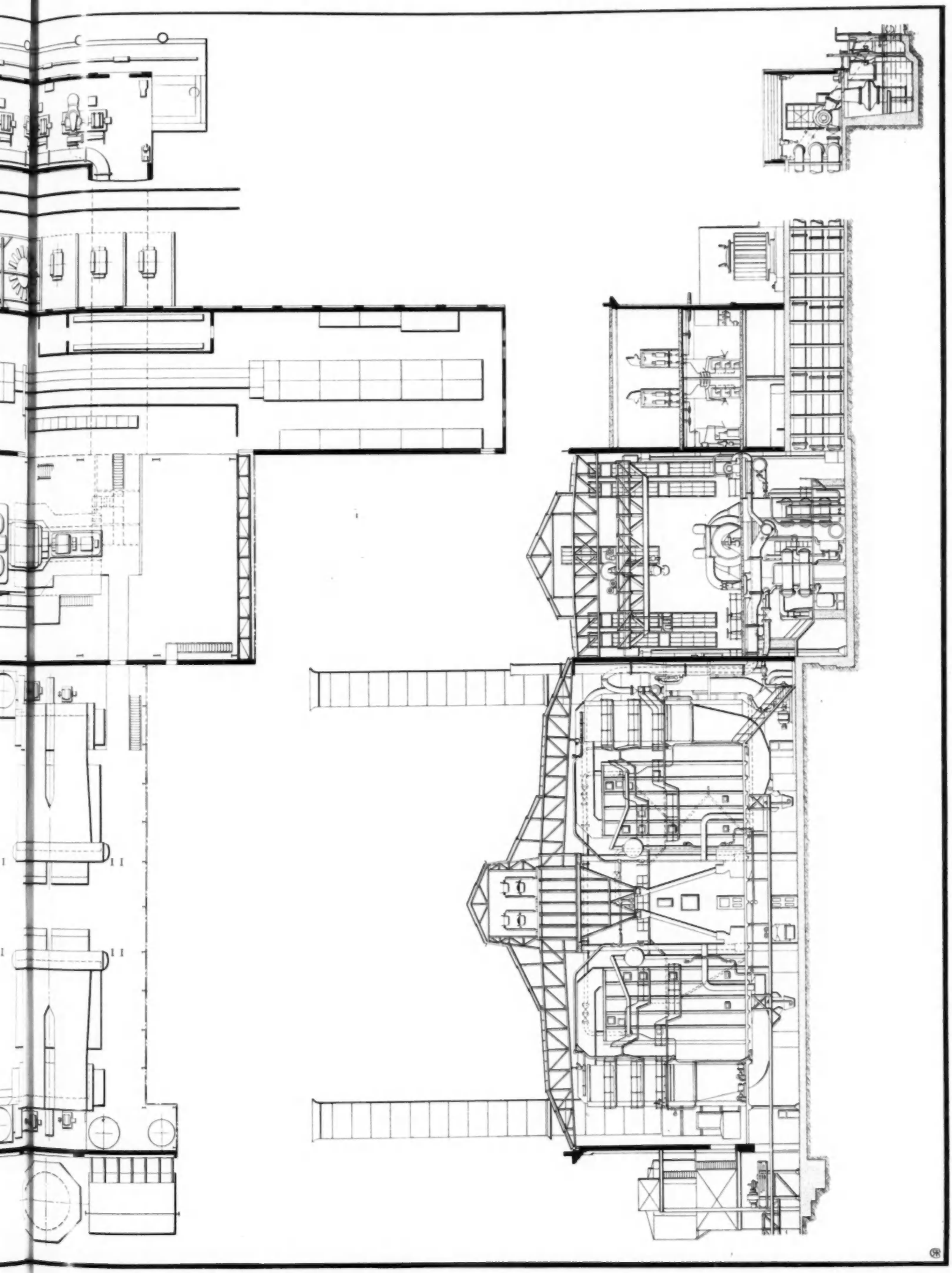

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### DEATH.

ON August 3rd, as the result of an accident, RICHARD CHARLES CLINKER, Chief Research Engineer to the British Thomson-Houston Company, Ltd., Rugby, age 57.


# THE ENGINEER.

VOL. CLII. No. 3943

*AUGUST 7, 1931.*


### The Efficiency of Kearsley.

THE Lancashire Electric Power Company has a right to be proud of the work of its engineers. They earned a high reputation many years ago by the operating results of the old Radcliffe station, but their first real chance came when the second station of the company was built at Padiham. This plant, as will be remembered, created a record in 1928, with a coal consumption of 1·33 lb. per kWh and a thermal efficiency of 21·35 per cent., thus proving itself to be the most efficient of all the 332 public steam power stations then operating in Great Britain. Since those days new rivals, capable of still better figures, have come into the field; but once more all have been outclassed by the wonderful performances of the company's latest station at Kearsley. This station has won a new efficiency record for the company. According to the recently published returns of the Electricity Commissioners, it produces power for an average coal consumption of only 1·17 lb. per kWh, its thermal efficiency being officially recorded at 23·84 per cent. as the average over a year. Such figures are not obtained by chance. Whatever certain modern physicists may think as to the behaviour of individual atoms or electrons being conditioned by the law of probability, nobody has yet arrived at the point of believing that power stations behave otherwise than in accordance with the skill of their designers and operators. Some, certainly, have natural advantages over others, but there is no reason to include Kearsley among them. Its results are not to be explained by magnitude of output, for stations with more than three times the output of Kearsley fail to attain them. Nor can they be attributed to special advantages in the matter of steam pressure or temperature, for the steam conditions of Kearsley are theoretically inferior to those existing in most modern plants. Nor can load factor be assigned as the cause, for even if it could be demonstrated that load factor had, in itself, any sensible influence on fuel economy, the load factor of Kearsley is exceeded by many of its competitors.

All these considerations emphasise the interest which the performance of Kearsley has aroused amongst central station engineers. What, then, are the secrets of Kearsley's success? This is an insistent question, and we hope to do something to provide an answer by the description of the station, which, by the courtesy of Mr. C. D. Taite, the engineer and manager of the company, we conclude in this issue. We are tempted to say, in the first place, that there are no secrets, for there is nothing to conceal, Mr. M. H. Adams, the generating engineer, and his staff being only anxious to put at our disposal every fact and every record which might be of service to other engineers. Our account of the station largely tells its own tale, yet even so there is a moral to be pointed out. This is that, provided the underlying conception of a station is sound, the nature of its equipment is virtually predicated. Kearsley was designed for the work it had to do. So was Padiham. The stations differ in such important details as steam pressure and temperature, system of feed heating, type of boilers, system of draught, air heating, and so on. Yet it would be totally wrong to think that Mr. Adams' ideas had changed with regard to all these matters in the few years between the construction of the two plants. Both designs are consistent with the ideal of building a power station for its own special and particular duties, regardless of what fashion or custom may prescribe. If, on the other hand, one seeks for points of similarity between Padiham and Kearsley, they are as readily found as the points of difference. In both stations simplicity of equipment and straightforwardness of lay-out have been studied with intense care. Operation is rendered easy and supervision almost inevitable by the excellence of the natural lighting and the accessibility of all auxiliary plant. Cleanliness is more a consequence than a virtue, and efficient maintenance is rather a state than an activity. Under such conditions economical operation is almost assured, particularly when, as in the case of Padiham and Kearsley, a rigorous and continuous control is exercised over the behaviour of all essential apparatus. This does not imply either an extravagant equipment of instruments nor a multiplicity of minor and unusable records. Few modern boiler-houses indeed are run without a far more imposing array of meters of all kinds than can be found at Kearsley and Padiham, yet the exceptional efficiencies of these plants is evidence that they have enough. Here again it is largely a question of design, for instruments can only be reduced to the desirable minimum if the plant is working under conditions which render their multiplication unnecessary. So far, it may be objected, we have said nothing to show that Kearsley was designed in accordance with any other principles than those which would be subscribed to by all power station designers. Everybody knows that simplicity, accessibility, and good lighting are cardinal virtues, and though Kearsley embodies them all to an exceptional degree, they, in themselves, are not sufficient to account for the thermal superiority of this station over all its rivals. Both Kearsley and Padiham are, however, distinguished by two features to which Mr. Adams ascribes no small importance. One is that the boilers and grates are made large enough to be worked at very easy ratings. The competition of stoker manufacturers to claim the highest rates of combustion, and the rivalry of boilermakers as expressed in rates of evaporation, are certainly not conducive to operating efficiency, whatever may be the results of special tests. The fierce draughts necessary cause constant anxiety about excess air, besides blowing grit and unburned particles of fuel through the boiler, and sometimes into the atmosphere. If boilers were more often tested at partial loads, instead of at their so-called rated capacity, there would be far less enthusiasm about running them at nearly their maximum output. The saving of capital cost and of floor space is usually given as the reason for high ratings, but to justify this argument it should be shown that the savings are greater than the losses. Kearsley, built at a total cost of only £14·1 per kilowatt, with a sustained boiler-house efficiency of 83·8 per cent. excluding auxiliaries, stands as Mr. Adams' argument to the contrary. It is not, however, sufficient to generate steam cheaply; it must be used to the utmost advantage. Here again we find Mr. Adams departing from ordinary practice. Steam at Kearsley is looked on as far too valuable to be used for anything but the generation of power in the main turbines. Its employment for subsidiary purposes, such as the extraction of air from the condensers, for evaporating the make-up feed water, for operating a de-aerator, or for driving auxiliary machinery of any kind, is contrary to the principle on which the station was designed. Evaporators and de-aerators are done without, the make-up being softened by chemical means and freed from gases by passing through the condenser. The air

ejectors are operated by water, and all auxiliary power is provided by electric motors. So fully is the principle of using steam only for power carried out that steam is only taken from the turbines for regenerative feed heating after it has expanded to low pressures. The economisers have to supply what further heat is required. They, together with the air heaters, reduce the exit temperature of the flue gases to about 230 deg. Fah., the figure for each boiler being constantly under observation.

Such, in brief, are the principles which have dominated the design of Kearsley. Their justification is the performance of the station, and this in turn is the justification of our opening sentence.

### The Profession of Salesmanship.

With modern production methods and with modern aids to the disposal of manufactured produce it is not a particularly difficult task to effect the first sales of any article fulfilling a useful purpose. The real problem facing manufacturing industry lies in maintaining sales following the initial period. This remark applies whether we are considering the introduction of a new article into a familiar market or the introduction of established products into a market not previously cultivated. Successful industry does not consist simply of making the goods and then disposing of them at a profit. The goods and the manner in which they are sold must be such as will encourage or ensure future sales. It is very commonly assumed that the duty of ensuring the maintenance of sales following the introductory period rests primarily with the manufacturing side. Undoubtedly that side has a highly important part to play in adjusting its products to the local requirements and peculiarities of each particular market, of adapting them to changed conditions as they may arise, and of effecting improvements in them which as time goes on will lead the market to retain its initial interest in the goods. The salesman, however, has also a vital part to fulfil in the business. It is to him in the first instance that the manufacturing side is entitled to look for guidance and advice concerning opportunities for the introduction of its products into the markets of the world. It is he who should know the local requirements, and it is he who should advise the production side how best to adapt the goods to those requirements and to the changes which may occur in them.

If this conception, and all that by inference it entails, of the salesman's duties be accepted it is easy to perceive in the final report of Sir Francis Goodenough's Committee on "Education for Salesmanship" an underlying unity of principle which otherwise might be lost in the mass of detail which the report contains. Salesmanship as the term is interpreted in the report is given a much wider significance than has hitherto commonly been attached to it. The salesman, it is clear, is properly to be regarded as the co-equal of the producer, and not as one wholly subservient to him. His knowledge of the product sold, its uses and its adaptability must be extensive and fully technical, and combined therewith he must have an expert's acquaintance with his market's requirements, customs, language and potentialities. The ready tongue and the persuasive manner are no longer sufficient. His is a profession demanding as prolonged and as thorough a period of education and training as that assigned to most of the other professions. It is on this question of education and training for salesmanship that the report chiefly addresses us. It is highly interesting to observe that the Committee's recommendations, when they are broadly summarised, amount simply to this: that the guiding principles of education for salesmanship should be the same as those of education for any other leading profession. In its opinion a period of general education and of mind and character building at school should be succeeded by a period of technical training at the works of the firm whose products the pupil is destined to sell. Early specialisation in salesmanship is deprecated. Even if a period at a university intervenes between school and works, the Committee favours the view that, in general, the student should not specialise, but rather develop his mind by the study of such subjects as history, law, logic, and science. The correct period at which specialisation should begin, it is held, is when the pupil is in contact with the works and with the conditions under which the goods which he is to sell are produced in practice. To that end it is recommended that facilities should be provided within working hours, possibly in conjunction with educational institutions, for the special training of the pupil salesman.

The report raises the status of the salesman to a very high level, but no one who has studied the subject at all closely will hold that it is too high. The term "salesman" still carries with it certain prejudices, the origin of which it is not difficult to trace to the earlier conception of the duties and standing of "bagmen." It is no longer a case of practising an art, but of following a profession as useful, as important, and as interesting and absorbing as any calling can be. Recognition of that fact is required in three distinct quarters. It must be recognised, not by a few enlightened employers, but by all, certainly by all transacting business in overseas markets. It must be recognised by educational authorities in order that they may adapt their curricula for the general and specialised training of salesmen. It must be recognised by parents and their children in order that a satisfactory volume of recruits of the right ability and character for the profession may be forthcoming. At present there is still a prejudice against commerce as a career, although there are clear signs that it is departing. In spite, too, of some noteworthy exceptions, educational establishments still regard education for commerce as being less important than education for industry. As a commercial nation, dependent in a peculiar degree upon our commercial transactions with overseas countries, the position can hardly be accepted as satisfactory. There is certainly room for a great development. It may well be that the industrial revival for which we are all looking will spring, not from the widespread application of electrical power, as some prophets promise, but from the galvanic effect which the development of our salesmanship is capable of creating. Since October, 1928, when it was appointed by the President of the Board of Education, Sir Francis Goodenough's Committee has studied from all angles the requirements for good salesmanship and how best they may be inculcated. We sincerely hope that the conclusions reached by the Committee as a result of its long and arduous labours will receive the attention and consideration which they deserve.

## The Present Position of the Fuel Oil Industries.

By JOHN B. C. KERSHAW, F. Inst. Fuel.

Four years ago the writer contributed to this journal a series of six articles under the title of "The Future of the World's Supplies of Liquid Fuels." In those articles the various processes for the production of fuel oils from coal and other raw materials were described, and official figures were given for the yields of oil and other by-products obtained by the different methods and processes. The present article is intended to bring the information and data given in the earlier articles up to date, so far as the necessary figures can be obtained. In those cases in which industrial developments of the processes have occurred, figures are included showing the present economic position of the company engaged in the commercial application of the particular process.

### Natural Oil Supplies.

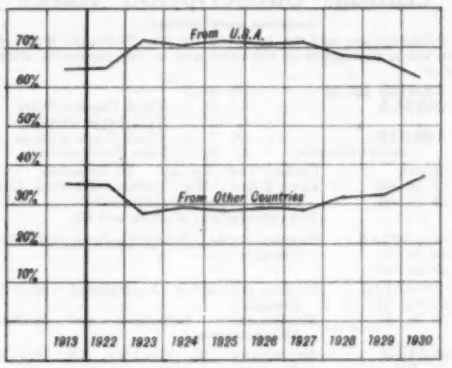
The comparative figures for the world production of mineral or natural oils for the pre-war year 1913 and for the post-war years 1922 to 1931 are given in Table I., and the two diagrams based upon the figures

Table I.—*Comparative Figures for the Total Production of Crude Oil in the Year* 1913 *and in* 1922 *to* 1931 *in Thousands of Barrels of* 42 *United States Gallons.*

| Year. | U.S.A. | World. | U.S. percentage. |
|---|---|---|---|
| 1913 | 248,446 | 383,547 | 64·7 |
| 1922 | 557,531 | 858,715 | 64·9 |
| 1923 | 732,407 | 1,018,900 | 72·0 |
| 1924 | 713,940 | 1,012,927 | 70·4 |
| 1925 | 763,743 | 1,067,566 | 71·5 |
| 1926 | 770,874 | 1,095,934 | 70·4 |
| 1927 | 901,129 | 1,262,582 | 71·4 |
| 1928 | 901,474 | 1,324,733 | 68·0 |
| 1929 | 1,006,587 | 1,482,517 | 67·9 |
| 1930 | 896,694 | 1,403,500* | 63·2 |
| 1931 | 850,000* | 1,360,000* | 62·5 |

* Estimated.

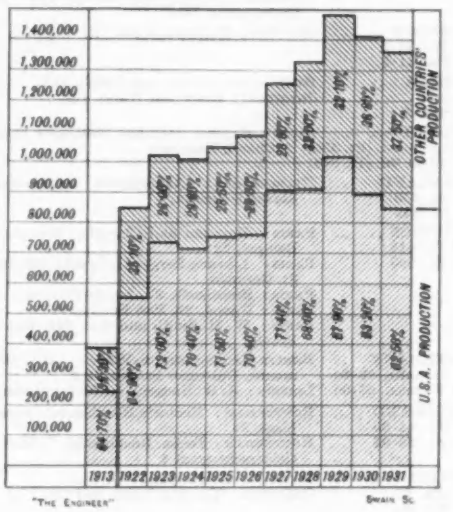
contained in this table show still more clearly the changes which have occurred during the last ten years in the sources and output of crude oil. In 1913 the total world output of mineral oil was 383,547,000 barrels of 42 U.S. gallons each, and to this total the U.S. contributed 248,446,000 barrels, or 64·7 per cent. For the current year the world output of crude oil is estimated at 1,360,000,000 barrels, or over three times the total of 1913. To this huge output the U.S. oil fields are estimated to contribute 850,000,000 barrels. The proportion of crude oil obtained from the American fields has dropped, therefore, to 62·5 per cent., as compared with the maximum of 72 per cent. which was attained in 1923. The first diagram shows as a curve the decline in the U.S.A. contribution during the last few years, and it is probable that this decline will continue, in spite of the fact that Texas has come to the front with a rush and has ousted




World Production of Mineral Oil

Oklahoma and California from their positions as the premier oil-producing states of the Union.

In Table II. the latest figures for the crude oil pro-




World Production of Mineral Oil

duction of all the countries of the world are gathered, and Table III. gives the figures for the imports into

Table II.—*The World's Crude Oil Production in Thousands of Barrels.*

| Country. | 1927. | 1928. | 1929. | 1930. |
|---|---|---|---|---|
| United States .. | 901,129 | 901,474 | 1,007,323 | 898,000 |
| Mexico .. .. | 64,121 | 50,151 | 44,688 | 39,530 |
| Russia .. .. | 77,018 | 84,704 | 99,507 | 135,165 |
| Persia .. .. | 39,688 | 43,461 | 42,145 | 45,420 |
| Dutch E. Indies | 27,459 | 32,118 | 38,072 | 40,150 |
| Venezuela .. | 63,134 | 105,749 | 137,472 | 137,675 |
| Roumania .. | 26,368 | 30,773 | 34,689 | 41,680 |
| Peru .. .. .. | 10,127 | 12,006 | 13,422 | 17,458 |
| India .. .. .. | 8,032 | 8,741 | 8,366 | 8,280 |
| Poland .. .. | 5,342 | 5,492 | 4,988 | 4,840 |
| Sarawak .. .. | 4,943 | 5,223 | 5,279 | 5,830 |
| Argentina .. .. | 8,630 | 9,070 | 9,391 | 8,910 |
| Trinidad .. .. | 5,380 | 7,684 | 8,716 | 9,120 |
| Japan .. .. | 1,789 | 1,944 | 2,010 | 1,950 |
| Egypt .. .. | 1,267 | 1,842 | 1,864 | 1,910 |
| Colombia .. .. | 15,014 | 19,897 | 20,385 | 20,346 |
| France .. .. | 504 | 512 | 497 | 520 |
| Germany .. .. | 663 | 630 | 711 | 1,161 |
| Canada .. .. | 477 | 624 | 1,121 | 1,500 |
| Czecho-Slovakia | 112 | 94 | 93 | 150 |
| Italy .. .. | 47 | 46 | 44 | 63 |
| Ecuador .. .. | 537 | 1,084 | 1,350 | 1,559 |
| Sokhalin, Russia | 440 | 677 | 1,076 | 1,670 |
| Iraq .. .. .. | 338 | 713 | 798 | 750 |
| Bolivia .. .. | — | — | — | 56 |
| Other countries | 23 | 24 | 34 | 30 |
| | 1,262,582 | 1,324,733 | 1,484,041 | 1,418,723 |

Table III.—*The Imports of Oil into the United Kingdom in Thousands of Gallons for the Pre-war Year* 1913 *and for the Post-war Years* 1925 *to* 1929.

| Character of import. | 1913. | 1925. | 1926. | 1927. | 1928. | 1929. |
|---|---|---|---|---|---|---|
| Crude oil .. | 1,108 | 569,082 | 537,444 | 664,810 | 498,001 | 487,348 |
| Refined oil : | | | | | | |
| Petrol .. | 100,858 | 404,834 | 562,092 | 533,216 | 734,737 | 810,084 |
| Fuel oil .. | 95,062 | 334,489 | 398,693 | 439,421 | 450,876 | 405,610 |
| Lamp oil .. | 157,141 | 141,649 | 201,950 | 214,084 | 189,763 | 255,032 |
| Lubricating oil .. | 67,962 | 84,361 | 91,816 | 91,592 | 105,429 | 98,018 |

this country of crude oil and of the various classes of refined oils in the pre-war year 1913 and for the post-war years 1925 to 1929. According to the Board of Trade returns, our imports of petrol in 1929 totalled 810,084,000 gallons, and were valued at the enormous sum of £22,750,000, which represented nearly two-thirds of the total value of our oil imports. The imports of crude oil for this same year amounted to

487,348,000 gallons and the total value was £4,762,000. It is unsatisfactory to note, however, that the imports of crude oil have dropped considerably since 1927, when 664,800,000 gallons were imported, for it would certainly be to our advantage to carry on the refining and upgrading of the crude oil in this country rather than to import the finished product.

The crude oil from the wells yields on refining an average of 20 per cent. of light oil or petrol, by what is called "a straight run," *i.e.*, without cracking. By cracking, the proportion of light oils obtained from the crude oil has been increased to 33 per cent., and in the near future it is probable that improvements in the methods of operating the cracking process will increase the percentage of light oils obtained from the crude oil to 40 per cent. The total British consumption of petrol in 1928 was 829,145,128 gallons and the estimated consumption last year was 950,000,000 gallons.

The prices at which petrol is retailed in this country have varied greatly in the last few years. No. 1 spirit is now sold at 1s. 3½d. per gallon, as compared with a maximum price of 4s. 3½d. per gallon in 1920 and with 1s. 7d. in 1912.

This summary of the latest figures relating to the production of crude and refined oil shows that up to the present time there is little sign of the exhaustion of the reserves of natural oil fuel. Until there is a considerable falling off in the output of the oilfields of the Eastern and Western hemispheres, and a consequent rise in the price of the refined oil, the economic prospects for the new processes of oil production from coal and from other raw materials will remain under a cloud. However, the time is bound to arrive when the supplies of natural oil will fail, and it will then be found that the energy, scientific knowledge and capital expended upon the investigation and development of alternative sources of liquid fuel supply have not been in vain. The improvements which have been made in the compression-ignition type of engine in the last few years have rendered it possible to make use of heavy crude oils for road transport purposes. This great step forward may be expected to have a stimulating effect upon the demand for the heavy oils. The companies which are working low-temperature carbonisation processes, therefore, ought to find it possible to market some portion of their crude oils at a profit and to obtain a better price than the 2d. or 3d. per gallon which is all they are getting at the present time. These low-temperature oils contain a mixture of the saturated and unsaturated paraffin oils, naphthalene, and complex aromatic hydrocarbons. According to Dr. Ormandy, although the low-temperature process yields a little more motor spirit than the high-temperature process per ton of coal carbonised, this spirit is not so rich in aromatics and is not so valuable in consequence, while the heavy portion of low-temperature tar is not easily cracked. This difficulty is due to the presence of emulsified water, and also of hydrocarbon bodies of the cresylic acid type. Low-temperature carbonisation, he considers, will undoubtedly grow into a large industry, but means must be found for converting the heavy fractions into low boiling fractions, if the yield of motor fuel or petrol substitute is to contribute largely to the country's requirements. (From a paper read before members of the Institute of Fuel, December 10th, 1928.) The aggregate amount of heavy and light oil obtained from the four low-temperature plants now operating upon an industrial scale in this country, however, is still under 6,000,000 gallons, or less than 1 per cent. of the estimated petrol consumption of the country. It is evident, therefore, that a very considerable expansion of the low-temperature process and industry will be required before the output of oil from this source can be regarded as a substitute for the natural product. Assuming that a yield of 20 gallons of oil could be obtained per ton of coal carbonised, over 50,000,000 tons of coal would have to be submitted to the process annually at the present time in order to provide the oil requirements of the motor industry alone.

### The Maclaurin Process at Glasgow and Nuneaton.

The plant which was erected by the Gas Committee of the Glasgow City Corporation for operation of the Maclaurin process at the Dalmarnock works was described and illustrated by the writer in the article contributed to The Engineer of December 14th, 1928. The operating figures given in that article for the two years ending May 31st, 1927, and May 31st, 1928, showed losses of £7304 and £2391 respectively, after paying interest and sinking fund charges on the capital outlay of £47,000. The price obtained for the oil was 6·3d. per gallon for the first year and 4·0d. per gallon for the second year, while the gas was sold at 1½d. and at 2d. per therm in the two years respectively.

The figures for the year ending May 31st, 1930, are given below, and it will be seen that, in spite of the somewhat larger revenue derived from the sale of the by-products, the Dalmarnock plant is still operating at a loss.

*Expenditure.*

| | £ |
|---|---|
| Coal, 15,500 tons at 18s. 8·396d. per ton | 14,492 |
| Wages | 3,322 |
| Repairs, &c. | 2,600 |
| Rates, taxes, &c. | 2,046 |
| Interest and sinking fund | 3,511 |
| Total expenditure | £25,972 |

*Revenue.*

| | £ |
|---|---|
| Smokeless fuel, 7853¼ tons at 22s. 4·27d. per ton | 8,779 |
| Gas, 501,137,466 cubic feet, or 1,148,812 therms, at 2d. per therm | 9,573 |
| Crude oil, 277,462 gallons at 2·1d. per gallon | 2,417 |
| Stock of coal, 953 tons at 18s. 9d. per ton | 893 |
| Stock of smokeless fuel, 320 tons at 25s. per ton | 400 |
| Balance (loss) transferred to revenue account | 3,909 |
| | £25,972 |

The sales of the carbonised fuel, which is called "Kincole" in Glasgow, for the twelve months ending May 31st, 1930, amounted to 7853 tons, and was only slightly larger than the total sold in the previous twelve months, namely, 7048 tons. The difficulty of increasing the sales in Glasgow is the same as that which hampers the sale of smokeless fuel in other places, namely, it is rather dearer than the cheaper types of ordinary house coal. The average householder in Glasgow, as in other places, is not yet educated up to the point of paying more for a smokeless fuel, and the writer fears that until its use is made compulsory in all large towns and cities this obstacle to progress will remain.

A further difficulty in making the process pay at Glasgow is due to the fact that the Maclaurin retort is of the continuous internally heated type. This reduces the cost of operation and simplifies the construction and upkeep of the plant; but the disadvantages of this type are serious, since it produces less coke per ton of coal carbonised than externally heated retorts, and the gas produced, though larger in volume, is of very low calorific value. The recovery of the light oils or of the ammonia from such large volumes of dilute gas is impracticable, and the revenue from the by-products of the Maclaurin process is therefore confined to that obtained by the sale of the gas and the crude oils. As shown from the figures given above, the prices obtained at Glasgow for these are at present insufficient to enable the plant to be operated at a profit. The yields per ton of coal carbonised for the year ending May, 1930, compared with the yields obtained during the test carried out by the chemists of the Fuel Research Board, are contained in the table given below. The test was made in May, 1928.

| By-product. | Fuel Research Board test in 1928. | Actual yields for year ending May, 1930. |
|---|---|---|
| Smokeless fuel, in cwt. | 12·12 | 11·26 |
| Gas, in cubic feet | 33,160 | 34,560 |
| Value of gas, in therms | 77·26 | 79·0 |
| Crude oil, in gallons | 17·8 | 19·1 |
| Petrol, in gallons | 1·5 | — |

The crude oil obtained at Dalmarnock is sold to the Chemical Department of the Glasgow Corporation and is treated with the other tar oils from the various gasworks of the city. So far as the writer is aware, no special treatment is applied to the Dalmarnock oil with a view to obtaining light oils suitable for motor transport work.

A plant for operating the Maclaurin process is also in use at Nuneaton and is being run by the company which supplies gas to that town. No recent particulars of the costs of operation of this plant are available for publication in this article, but the following are the yields per ton of coal carbonised:—

100 Therms, in gas testing 200 B.Th. units.
9½ cwt. coke.
22½ gallons crude oil.

This plant has a capacity of 20 tons coal per day.

### The Low Temperature Carbonisation Company's Plants at Barugh and Askern.

The firm known as Low Temperature Carbonisation, Ltd., is the oldest of the numerous companies which have been formed to exploit the manufacture of smokeless fuels in this country. It owns the works at Barugh, in South Yorkshire, and is also interested in the subsidiary company, Doncaster Coalite, Ltd., which has erected another large plant at Askern, in the centre of the South Yorkshire coalfields. A third plant has also been erected by the parent company at East Greenwich for the South Metropolitan Gas Company. The capacity of these three plants is as follows:—

| | Carbonising capacity, tons per annum. |
|---|---|
| Barugh, 160 retorts | 91,000 |
| Askern, 144 retorts | 75,000 |
| Greenwich, 180 retorts | 100,000 |

The total carbonising capacity of the three plants is therefore 266,000 tons of coal per annum. The reconstructed plant at Barugh has now been in continuous operation for four years, that at Askern for two years, and the Greenwich retorts for some six months. Assuming that an average yield of 14 cwt. of coalite and of 18 gallons of crude oil, with 2½ gallons of petrol, is obtained from these plants per ton of coal carbonised, the aggregate annual output of these by-products from the three works will be:—Coalite, 186,200 tons; petrol, 665,000 gallons; and crude oil, 4,788,000 gallons.

Although the demand for the products of these works is satisfactory, the prices obtained have not yet enabled the parent company to show any profits after meeting maintenance charges and debenture interest. The accounts for the year ending October, 31st, 1930, reveal a debit balance of £9317, as compared with one of £4494 for the previous fifteen months' trading. The British Admiralty is taking large quantities of the crude oil for fuel purposes in the Navy, but in order to overcome the difficulties caused by the low price obtainable for the crude oil the parent company has erected an oil refining plant at Barugh, with a capacity of 4,000,000 gallons per annum. The directors have also promoted the formation of a subsidiary company named Petroleum Refineries, Ltd., for the erection and operation of a refinery and cracking plant at Killingholme, near Hull. This subsidiary company is operating a process known as the Gyro process of oil cracking and refining. It is of the low-pressure vapour-phase type, and the motor spirit produced by it is characterised by high anti-knock qualities and is therefore useful for raising the value and price of ordinary motor fuels. The new company has a paid-up capital of £435,000 and had expended at the date of its last report £230,168 upon the construction and equipment of this works at Killingholme. The Gyro process, and the yields obtained by it, have been described in detail in a paper by W. S. Jones, which was read before the members of the Institute of Fuel in April, 1930, and will be found in the *Journal* of that Society. According to Jones, the vapour-phase cracking processes are coming into renewed favour with oil refiners, because they produce petrols of high anti-knock value. The plant at Killingholme is equipped with cracking units and oil refining columns capable of dealing with between 3000 and 4000 barrels of crude oil per day, or 30,000,000 gallons of oil per annum. The cracking process as operated at Killingholme is controlled as far as possible by automatic instruments for recording the temperature and flow of the oil, and in the control house instruments are installed which record the temperature at fifty different points. The total oil capacity of the storage tank "farm" is 12,000,000 gallons, the tanks varying in size from 1500 to 8000 tons. At the date of the last report the stocks of crude oil and of petrol were valued at £59,035. Owing to the fact that the works required much longer to erect and equip than was anticipated, no trading had been carried on at the date of the last report, which covered sixteen months, ending June 30th, 1930, and the debit balance of £13,868 shown in the profit and loss account represented the expenses of administration and development during the construction period. The next report of this company covering the twelve months ending June 30th, 1931, will be awaited therefore, with interest.

### The Illingworth Low-temperature Carbonisation Process.

The Illingworth Carbonisation Company, Ltd., was formed in 1922 to develop certain patents relating to low-temperature carbonisation taken out by Dr. S. Roy Illingworth—see The Engineer, August 9th, 1929. Plants for working this process have been erected at Pontypridd in South Wales in connection with the local gasworks, at Allerton, near Leeds, and at one of the newly developed collieries in Kent for Messrs. Pearson and Dorman and Long. The writer has not been able, however, to obtain any figures for the working of this process other than those already published, and he is unable to give any estimates of the present production of smokeless fuel and liquid by-products by this process.

### The Salermo Process at Fulham.

The Salermo process of coal carbonisation is still being worked experimentally at the works of the Gas Light and Coke Company at Fulham. The original retort was described by the writer in The Engineer for October 4th, 1929. This retort has now been pulled down and replaced by a smaller one, in which the troughs containing the fuel are separately heated and the process of carbonisation therefore is under better control. The only large-scale installations of the Salermo process, however, appear to be those abroad. At the Heinitz Coke Ovens, on the Sarre, there are five retorts at work, each dealing with from 40 to 45 tons of washed fines per twenty-four hours. This plant has been in operation since 1927. Another Salermo plant is in use at the Langerbrugge generating station of the Centrales Electriques des Flandres. The latter installation is producing coke fuel for use on chain grates, the coke being first pulverised. A Dubbs cracking plant is run in connection with this carbonising plant for the purpose of upgrading the crude oils. A description of the plant was given by W. S. Jones in the paper upon cracking already referred to, but no technical or financial data of the operation of the Salermo process in this country or abroad are available for publication.

## BOOKS RECEIVED.

*The Institution of Mechanical Engineers Proceedings*, 1930. Vol. 2. London: The Institution of Mechanical Engineers, Storey's-gate, S.W. 1.

*The Institution of Heating and Ventilating Engineers.* Vol. 29. London: The Institution of Heating and Ventilating Engineers, 12, Russell-square, W.C. 1.

*The Elements of Machine Design.* By Wilfrid Collins, B.Sc., &c. London: Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 12s. 6d. net.

*The Principles and Practice of Geophysical Prospecting: Being the Report of the Imperial Geophysical Experimental Survey.* Edited by A. B. Broughton Edge, B.Sc., &c., and T. H. Laby, M.A., &c. London: The Cambridge University Press, Fetter-lane, E.C. 4. Price 15s. net.

# The Grampian Hydro-Electric Power Scheme.

No. I.

A NOTEWORTHY advance in the development of the water power resources of this country took place on November 30th, 1930, when current from the recently completed hydro-electric power station at Rannoch of the Grampian Electricity Supply Company was made available for public supply in the area of the Company and linked up to the national "Grid" at Abernethy, thus connecting the Grampian plant to the power stations of Edinburgh, Glasgow, Dundee, &c. The "switching-on" of the current, which was carried out successfully, was performed by Mr. George Balfour, the Chairman of Balfour, Beatty and Co., Ltd. The power station at Rannoch was the second hydro-electric station of importance to be put into operation in this Country during the year 1930, the first being the Lochaber hydro-electric plant at Fort William, for the British Aluminium Company, Ltd. The Lochaber scheme, which was fully described in our issues of April 25th, May 2nd, and May 9th, 1930, was designed by Messrs. C. S. Meik and Halcrow, Consulting Engineers of Westminster; Balfour, Beatty and Co., Ltd., being the contractors for the whole of the civil engineering works. In the case of the Grampian undertaking, Balfour, Beatty and Co., Ltd., were responsible not only for the design, but also for the construction of the whole scheme, Mr. W. T. Halcrow, M. Inst. C.E., acting as advising civil engineer.

The possibility of utilising the waters of the Upper Tay and its tributaries for the production of electrical energy had been under consideration for a good many years before the constitution of the Grampian Electricity Supply Company. The Water Power Resources Committee, which was appointed under the Chairmanship of Sir John Snell, by the Board of Trade in 1918, had the matter under review. That Committee, it will be remembered, had, as its first terms of reference, "to examine and report upon the Water Power Resources of the United Kingdom and the extent to which they can be made available for industrial purposes." Those terms were subsequently enlarged by the addition of the instruction—"To consider what steps should be taken to ensure that the Water Resources of the country are properly conserved and fully and systematically utilised for all purposes." Acting under the powers thus conferred upon it, the Committee called for and obtained reports from leading engineers on various possible sources of supply of energy. Among the reports received was one on the Rivers Tummel and Garry, which was prepared by the firm of Sir Alexander Binnie, Son and Deacon, of Westminster, and from that Report the Grampian scheme, the first portion of which has recently been completed, may be said to have been developed. The present undertaking, however, differs from the suggestions made in the Report in a number of particulars.

The map shown in Fig. 1 gives an idea of the scope of the Grampian Scheme. The present development entailed the building of a dam across the upper part of the River Truim to divert its flood waters, or a portion of its flow, into the upper end of Loch Ericht. The Truim is a tributary of the River Spey, in Inverness-shire, but it, and certain of its tributaries, rise within the watershed inside which the Grampian Company has been given rights. This dam and the conduit through which the water is diverted into Loch Ericht will be described later. Loch Ericht is drained by the River Ericht, flowing out at its southern end, into Loch Rannoch, which lies to the south-eastward of it at a distance of about 4 miles, the difference in level between the two Lochs being originally 485ft. To raise the level of Loch Ericht, a dam has been built across the River Ericht, and to lead the water the more effectively from the Loch to the dam on its way to the power-house, and to increase the draw-down, an open cut has, as we shall explain later, been excavated from some distance from the original shore of the Loch to the dam site. From a point upstream of the dam a valve tower gives access to a tunnel driven under several hills in the solid rock to a portal above Loch Rannoch, whence the water is taken in pipe lines down to the power-house, which is built on the shores of Loch Rannoch, near to its westward end.

The above describes in outline the present development of the scheme. Future developments include the following additional works shown diagrammatically in Fig. 1, and may be briefly enumerated as follows:—

(*a*) To construct a dam to the northward of and about a mile away from Lochan T. Seilich—see the right-hand top corner of Fig. 1—and to raise its level, and to lead the discharge from the Loch and its watershed through a tunnel into Loch Cuaich lying to the West.

(*b*) To run a conduit from the south-westward end of Loch Cuaich to divert the discharge from that Loch into Loch Ericht.

(*c*) To construct a dam at the northern end of Loch Ericht and raise the level of the Loch.

(*d*) To construct a conduit which will lead the head waters of a stream known as the Allt Sluic, which at present flows into the Truim near Dalwhinnie, into Loch Ericht.

(*e*) To raise the level of Loch Garry and lead into it, by means of conduits, the waters of several small streams at present discharging outside the watershed, and to connect Loch Garry with Loch Ericht by a tunnel.

(*f*) To construct a dam at the north end of Loch Duin and divert the Edendon Water by means of a conduit into it. The discharge from this Loch would be by means of the stream which already connects its northern end with the southern end of Lochan T. Seilich, described under sub-heading (*a*).

The effect of all these works will be to raise the level of Loch Ericht and to increase the volume of water which it will be possible to draw from it, and hence the energy which it will be possible to derive from it. Provision is made in the present scheme for these subsequent developments.

(*g*) It is also proposed by means of two conduits to divert into the present scheme the head waters of the Killichonan Burn and other streams, which at present find their way direct into Loch Rannoch.

It will be seen on consulting Fig. 1 that Loch Ba, and its associated smaller lochs and their tributaries, in the western area of the gathering ground discharge through Loch Laidon and Loch Rannoch by way of the River Tummel to Loch Tummel. It is proposed to build a control weir at the outlet end of Loch Rannoch, which receives, in addition to the waters already referred to, the discharge from the Rannoch Power-house. This weir will not raise the level of the loch, but will simply regulate the run-off, and the discharge will flow, as it does now, down the River Tummel.

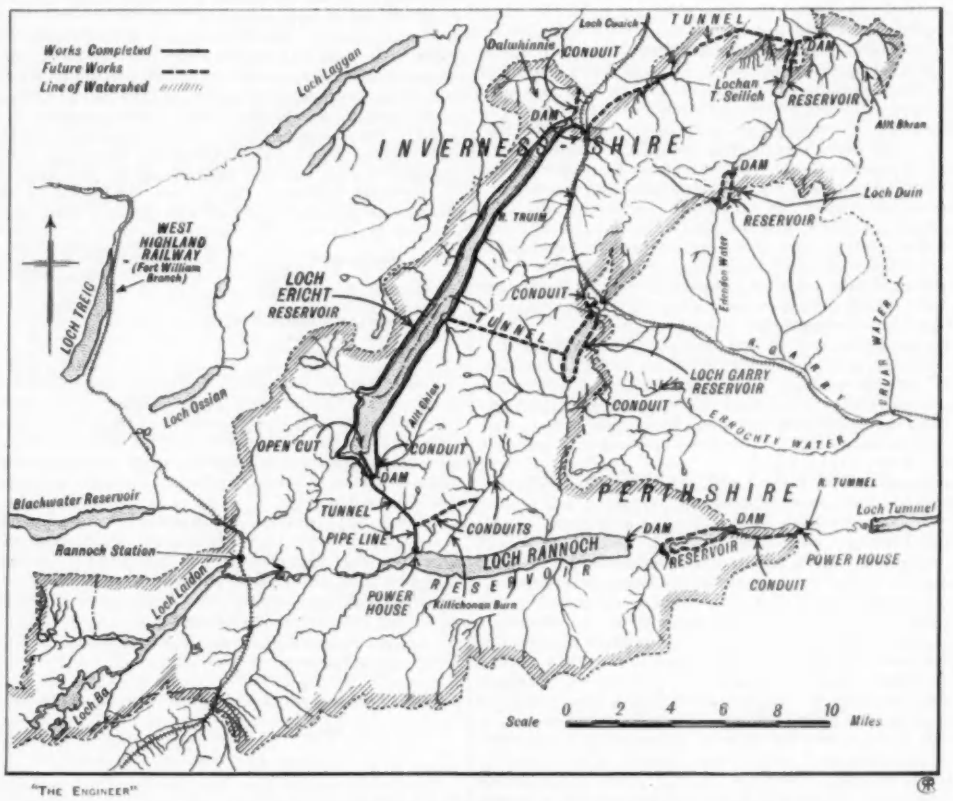



FIG. 1—MAP SHOWING THE GRAMPIAN HYDRO-ELECTRIC POWER SCHEME

With so much explanation we can proceed to the more detailed description of that part of the scheme which has recently been completed. Before doing so, however, we may say that although the works outlined under headings (*a*) to (*g*) inclusive remain for the moment in abeyance, measures were immediately taken as soon as the Rannoch Station was in operation to make a start on what is termed the Tummel portion of the scheme. As the winter months supervened, sometimes with severe frost and heavy snow, operations were, at first, for the most part confined to establishing the necessary camps and for making preparations for starting active operations as soon as more clement conditions of the spring would permit. We understand, however, that constructional work is now actively in progress.

By Act of Parliament the Grampian Electricity Supply Company is authorised to supply electricity for all purposes over an area of 4214 square miles in the counties of Perth, Forfar, Kinross, and in parts of the counties of Inverness, Argyle and Stirling. In addition, the Central Electricity Board contracted to take a load of 12,000 kW, and a further 12,000 kW on the completion of the Tummel plant. Pending the completion of the hydro-electric stations which it is permitted to build, the company, to meet the demand which was being created, acquired or erected small generating stations at Arbroath and Kingussie. The Bill was introduced into Parliament in 1922 and received the Royal Assent on August 4th of that year. It was not, however, until March, 1928, that preliminary work at Rannoch was started, the driving of the tunnel being begun in September of that year. When constructional operations were well under way, however, progress was exceptionally rapid, and, as we have said, the power-house was formally put into service on November 30th, 1930.

The total catchment area comprised in the Grampian scheme is 417·7 square miles, over which area the annual rainfall varies from 50in. to 100in. For the first development the catchment area is 75·26 square miles and the average rainfall is given as being 67·5in. per annum.

### TEMPORARY POWER SCHEME.

Returning now to the Loch Ericht section of the works, one of the first things to be done in such an undertaking is to estimate how much power will be required in the various construction works and how best to provide it. In the present instance it was decided to erect a small temporary power-house, to be operated by the waters of the River Ericht on its way to Loch Rannoch. A dam 25ft. maximum height and 150ft. long with a scour sluice was constructed in concrete across the stream and a pipe line 3300ft. long and 5ft. 4in. in diameter was laid, contouring the ground and on a falling gradient to the power-house. A steel surge shaft, 30ft. high and 20ft. diameter, was constructed of steel circular segments built up in sections and was erected on a concrete foundation built on the left-hand side of the valley. It was connected by a line of pipe 4ft. in diameter with the 5ft. 4in. diameter pipe line. The pipes were carried on concrete pedestals and were provided with anchor blocks and the necessary expansion joints, valves, &c. The pipe line was supplied by Messrs. Ashmore, Benson and Pease. The point chosen for the temporary power-house gave an available head of 135ft., and the flow of the stream was such that a minimum of 1200 H.P. could be depended upon. The control valve at the intake was a hand-operated butterfly valve and gratings were provided to prevent drifting matter getting into the pipe line.

In the temporary power-house were installed two

generating units, each comprising a turbine capable of developing 400 kW, made by Boving and Co., Ltd., coupled direct to a three-phase alternator made by the British Thomson-Houston Company, Ltd. Current was generated at 11,000 volts and transmitted to various points on the works by overhead cables. The plant was housed in a temporary corrugated iron structure equipped with an overhead crane and the usual switch and other gear. The position of the temporary power-house and its situation relatively to the other parts of the works may be seen in Fig. 2, while views of the intake and pipe line are given on page 144.

### CAMPS AND ACCESS.

Another thing which had to be arranged before starting construction works on such an extensive undertaking was how best to make provision for the housing, feeding, well-being and entertaining of a large body of workpeople. It was decided to build three camps, one, the main camp near the Mheugaidh shaft—see Fig. 2—another near the site of the Ericht Dam; and another near the power-house. The first well as a garage with a workshop, petrol pumps, &c.

In addition, to provide access to the Mheugaidh camp and to the works at the Ericht Dam, an access road, about 3 miles long, was constructed from the public road on the shores of Loch Rannoch. This road rises about 500ft. to the main camp and then continues at about the same level to the dam. As an old road to Ardlarach farm was crossed by the pipe lines, a new access road to the farm was also built, the embankment material for the work being furnished by the power-house excavation.

The water supply for the main camp was obtained from a small stream above the camp, a small reservoir having been constructed for the purpose. There were "wet" and "dry" canteens, from which the men could obtain any solid or liquid refreshment which they might require in addition to the camp catering. The hospital, sanitary and fire-fighting arrangements received careful attention, and every possible care was taken of the workpeople engaged on the undertaking. The nearest small village was 10 miles away and the nearest town of any size—Pitlochry—was 32 miles off. It may be mentioned, in passing, that,

## B.E.S.A. Specifications.

*All B.E.S.A. Specifications can be obtained from the Publications Department of the Association at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.*

### THE SAMPLING AND ANALYSIS OF COAL.

The preparation of British Standard Specifications for the Sampling and Analysis of Coal and Coke, which was begun in 1927 at the instance of the Department of Scientific and Industrial Research, has been brought a stage nearer completion by the recent issue of the British Standard Specification for the Sampling and Analysis of Coal for Inland Purposes (B.S.S. No. 420–1931). This specification should be read in conjunction with the report by Dr. E. S. Grumell and Dr. A. C. Dunningham on the sampling of small fuel up to 3in. (B.S.S. No. 403), issued in December of last year, as the report embodies some general principles of sampling, the explanation in regard to which is important as supplying justification for the comparatively speaking small samples specified in the specification.

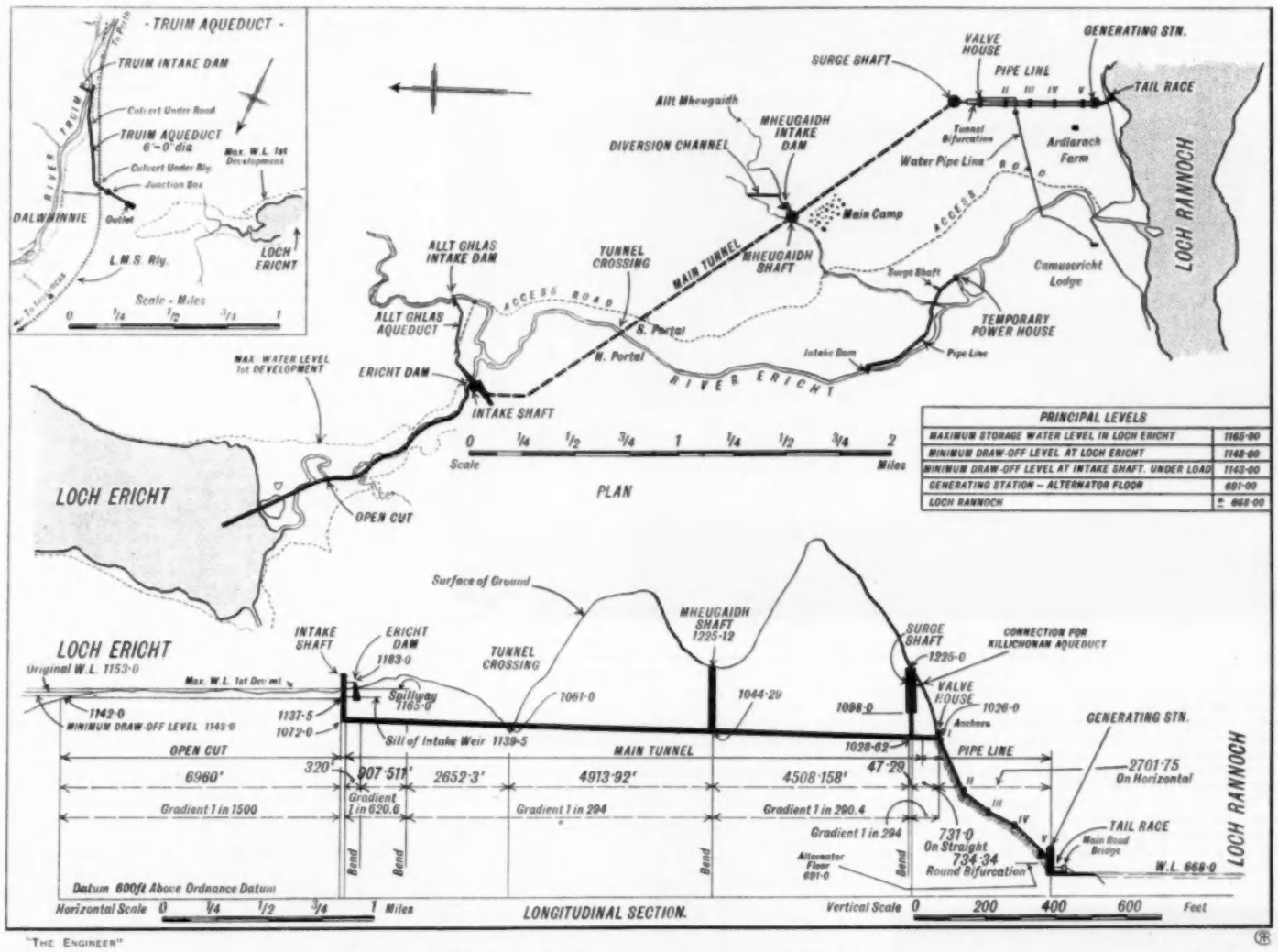



FIG. 2—DIAGRAMMATIC PLAN AND PROFILE OF RANNOCH POWER PLANT

two are at an elevation of some 1200ft. above sea level, while that at the power-house stands at about 700ft. We had an opportunity of examining all three of them, and a few words regarding the main and largest camp may prove of interest. It was capable of housing some 600 workpeople, the majority in dormitories each capable of holding forty beds. The buildings—which still existed when we visited the site—were of wood. They were well heated—a very necessary provision, seeing their altitude and the severity of the climate—and well lit. There were several well-equipped kitchens or cook-houses and numerous dining rooms. There were two recreation rooms, one of which was capable of seating 400 and in which sing-songs were held and entertainments, including a weekly cinematograph show, were given.

The local offices were at Mheugaidh camp and there, too, the members of the staff were housed and a large number of the men who were not only those employed in the neighbourhood of the camp itself, but others engaged at various points above and below the camp. The latter were carried to and from their work on a construction railway. This railway extended from the camp up to the Ericht Dam and along the open cut from the Ericht Dam to Loch Ericht. It extended in the other direction from the main camp to the valve house and portal at the top of the pipe lines, which will be referred to later. The length of this construction railway, which was of 2ft. gauge, was approximately 3 miles. At the central camp there were numerous sidings for unloading stores, &c., as on Saturdays, motor vehicles were available to take those men who desired further distractions than those available at the camps into that town and to bring them back again.

The nearest point on the railway to the works is Rannoch Station, on the Fort William Branch of the West Highland Railway, which is about 9 miles away. Along the roadway leading from that station the whole of the plant, materials, camp equipment and supplies for the *personnel* had to be transported, the work being done by petrol-driven tractors and lorries. The roadway was originally an old cattle drovers' track, and as it retained its original characteristics as regarded alignment and gradients it was necessary to improve it considerably in places and to strengthen several bridges before it was capable of carrying the heavy weights—the heaviest single loads being transformers weighing 60 tons each—which it was necessary to convey over it. As the road ends at Rannoch Station and does not afford access beyond that point, it has largely been allowed to remain in its original state, no more money than was required to render it sufficiently serviceable for transport purposes having been spent upon it. Over this road were hauled some 3000 tons of steel pipes, as well as all the equipment for the power-house, outdoor sub-station, &c. The 60-ton transformers were hauled on special bogies and the weakness of the road foundation caused considerable trouble in places.

*(To be continued.)*

The sampling section of the specification is at present confined to coal passing through a 3in. diameter perforated plate screen. The sizes of gross sample required are graded in accordance with the average ash percentage and the size of the fuel, and figures have been specified such that a gross sample taken in accordance with the specification should contain an ash percentage within ± one unit of the average ash content of the consignment. Full particulars are given of the method of collection of the gross sample from chutes, conveyors and wagons, and the method of reduction is closely specified.

As in the case of the export specification, the methods of analysis are the simple, practical methods used in sound commercial practice at the present time. Instructions are included for the determination of moisture, volatile matter, ash, calorific value, sulphur and arsenic, and in most cases alternative methods are put forward.

The question of the sampling of large screened coal and run-of-mine coal is still under consideration, and a comprehensive series of tests has been carried out by the collieries, power stations, gas companies, railways, and others throughout the country, which has already gone a long way towards ensuring a satisfactory solution to this very difficult problem. At the present time a tentative specification has been prepared, and it is proposed to carry out a further series of tests in order to confirm the proposed weights of gross samples.

A method has also been prepared for the determination of the fusion temperature of coal ash, and it is hoped to issue it early in the autumn.

Committees are still at work dealing with a British standard method for the determination of the agglutinating value of coal; whilst methods for the sampling and analysis of coke are being studied.

With reference to the specification for the sampling and

analysis of coal for export purposes, which was issued in December of last year, it is of interest to note that German and French translations of the specifications are now available and are finding a ready sale in the countries to which British coal is exported.

### CONVEYOR TROUGHING FOR MINES.

The British Engineering Standards Association has just issued a British Standard Specification for Conveyor Troughing for use underground in Mines. This new British Standard, which has been agreed to by all British makers of shaker conveyors, has been prepared with a view to securing interchangeability between the troughing used for the various types of shaker conveyors underground. A specification is also included for the material of the steel plates used in the manufacture of the troughing.

Three capacities of troughing have been standardised, but the types have been so designed that they can all three be manufactured from a single set of dies. It is hoped that this will considerably cheapen the cost of the troughing to the users.

## Glass Silk as a Heat Insulator.

REFERENCE has already been made in our columns to the use of glass silk for heat insulation on the boilers of the North German Lloyd liners "Bremen" and "Europa,"

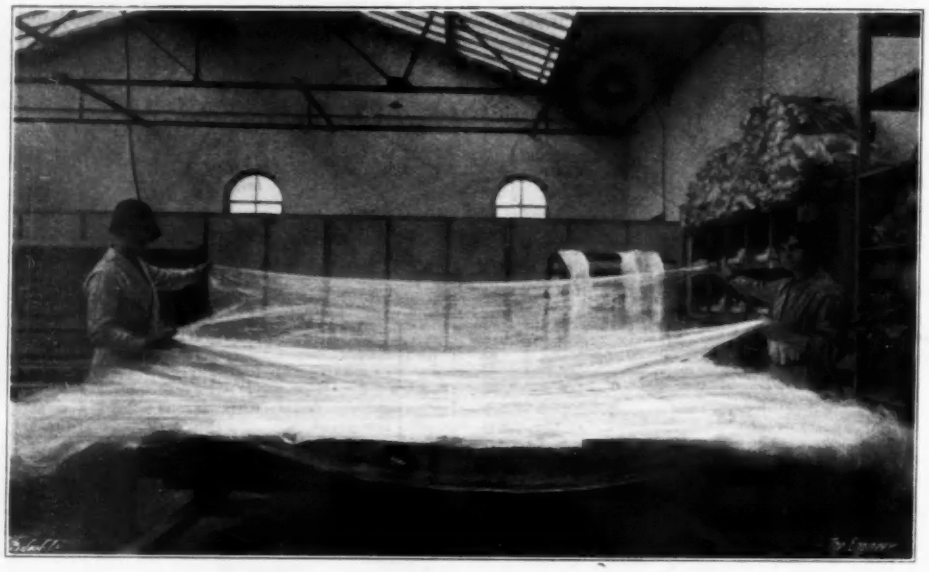


FIG. 1—SPREADING GLASS SILK FIBRE TO FORM A MATTRESS

while some months ago we announced that the manufacture of glass silk had been begun in Great Britain at the Firhill, Glasgow, works of Chance Brothers and Co., Ltd. The process employed is one which embodies the most up-to-date method of heating glass, and spinning glass silk fibres by an electrical process for which the firm holds the rights for the British Empire.

On the occasion of a recent demonstration at the Institute of Marine Engineers, London, Mr. Lindsay Forster, the managing director of Messrs. Chance's Firhill works, gave some further particulars with regard to the manufacture and use of glass silk as an insulating material.

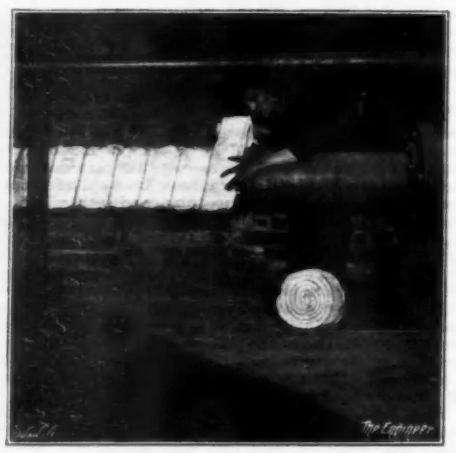


FIG. 2—COVERING PIPE WITH GLASS SILK STRIP

A feature of glass silk, which comes from the spinning department in a large hank containing many fine long fibres, is its ability to divide itself when spread out into the veil-like sheet, illustrated in Fig. 1. Successive sheets are spread out on a large table, one on top of the other, until the requisite thickness of material required is produced. The superimposed fibres form themselves into a firm mattress, which can be cut into strips or otherwise shaped to the desired form. All that is needed to cut the material so formed is a small steel knife.

For the covering of ordinary small-sized steam pipes the silk is made up into strips which have a thickness of either ¼in. or ⅜in. and are supplied in widths of 3in., 4in., and 6in., designed for use with pipes having outside diameters of 2in., 4in., and 6in. and over, respectively. A feature of the strip is that the width is such that the material can be sewn with asbestos thread, which keeps it in position, particularly when it is desired to cut it when forming the end splices. The method of application is indicated by Fig. 2. The glass silk strip is wound diagonally round the pipe, each lap being fitted snugly up against the next, so that air gaps are avoided and a uniform covering is given over the whole surface of the pipe.

The wrapping can be finished off in several ways, either with cement or metal cleading or by wrapping with canvas. The labour required for application is, it is claimed, considerably less than that for plastic materials or asbestos rope.

When manufacture was begun at Firhill, Messrs. Chance established a well-equipped laboratory for carrying out scientific tests on heat insulation materials, and extensive experiments have been made on the relative efficiencies of different thicknesses of glass silk covering.

The diagram which we reproduced in Fig. 3 shows some of the experimental and calculated results obtained from these tests. It shows the heat losses from an 8¼in. diameter pipe when uncovered, and when insulated with various thicknesses of glass silk. The calculated insulating efficiencies of glass silk are also given at the top of the diagram. Some valuable comparisons with standard magnesia coverings, which, we are informed, indicate the advantage of glass silk as a heat insulating material, have also been made.

It has often been objected that glass silk is difficult to handle, but it is noteworthy, as will be seen from Fig. 1, that the workers in the factory do not require protection either in the form of respirators, gloves or overalls, while the strip can be applied to a pipe surface by hand without experiencing irritation. At the demonstration we have referred to the process of covering pipes was shown by members of the technical staff of Messrs. Chance Brothers

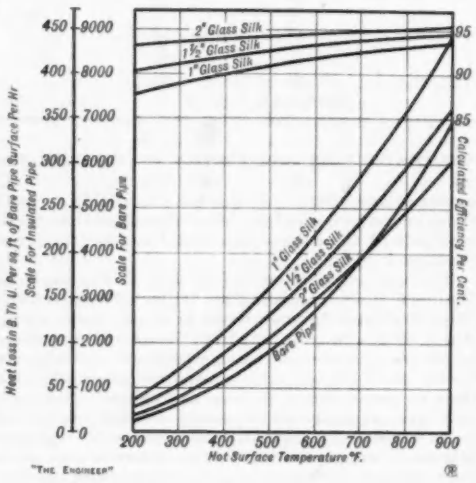

Heat Loss in B Th U. Per sq. Ft. of Bare Pipe Surface Per Hr
Scale For Insulated Pipe
Scale For Bare Pipe
Calculated Efficiency Per Cent.
2" Glass Silk
1½" Glass Silk
1" Glass Silk
Bare Pipe
450 400 350 300 250 200 150 100 50 0
9000 8000 7000 6000 5000 4000 3000 2000 1000 0
95 90 85
200 300 400 500 600 700 800 900
Hot Surface Temperature °F.
"THE ENGINEER"

FIG. 3—CURVES OF RESULTS OF TESTS

and also Ferguson and Timpson, Ltd., of 104, Minories, London, E.C. 3, which firm deals with applications of glass silk in the mercantile marine.

CELLULOSE is no use, as far as we know, says *Tin*, for hermetically sealed packages requiring heat treatment. Stainless steel has two fundamental objections. The first is that the price makes it prohibitive; and secondly, as the President of one of the largest American canning companies said the other day, "the housewife would need a stick of dynamite to open it!" Aluminium-coated steel corrodes with great rapidity and is both costly and useless.

## Swimming Bath Filtration Plant.

A FILTRATION plant for a sea water swimming bath at Redcar has recently been installed by the Pulsometer Engineering Company, Ltd., which was among the pioneers of bath water filtration in this country, its "Torrent" filtration system having been patented in 1883 and employed in the baths at Charing Cross in 1887, thus, it is claimed, providing the first example of the filtration of water for swimming baths in this country.

The plant described in what follows is at the new covered public baths at Redcar, and as it has to deal with heated sea water, which requires rather special handling, it is of particular interest. It is claimed by the company, however, that it is so simple to work that it can be operated by unskilled labour.

The plant includes three 7ft. diameter mild steel filters, designed to deal with 93,000 gallons of salt water in four hours, which is equivalent to just over 200 gallons per square foot of filtering area per hour. The strainer box is of large dimensions, and was specially designed with a view to avoiding risk of air locks, which might restrict the flow of water. In some filters there is a tendency to cut the dimensions of this part of the installation too fine, with the result that the plant may have to be stopped and the strainer changed, say, in the middle of the day's run instead of at the end when everything is shut down.

The pump by which the water is circulated is of the horizontal split-casing type, manufactured by the company, and, owing to the varying heads against which it is called upon to operate, special attention was paid to its characteristics so as to maintain, as near as possible, a constant rate of circulation.

A coagulating plant is employed to ensure the removal of strains from the water, and there is also a chlorinating plant, manufactured by Messrs. Wallace and Tiernan, designed to destroy vegetable and bacterial life in the water. The plant is totally enclosed, so that there may be no danger of gas overflowing into the filter room. An aerator is also provided to enable the water to be thoroughly aerated.

As there was no steam available on site, it was decided to install a high-pressure boiler to serve the dual purpose of heating the water in the bath to the required temperature, and of supplying steam for blowing out and cleaning the filters. The coagulants, which are used to ensure the removal of the impurities from the water, form a thin film on the surface of the filter bed. As filtration goes on the film, consisting of coagulant and the dirt, &c., arrested, grows in thickness, and, as it grows, the resistance of the filter to the passage of the water naturally increases. Periodically, therefore, the filter has to be cleansed by the removal of the film. In the Pulsometer Company's filter the cleansing is effected by means of compressed air. The air is delivered either from a steam blower or, where no high-pressure steam is available, from a rotary air blower, and admitted through a series of nozzles on the bottom of the filter bed. At Redcar the plant includes a steam blower which delivers air through specially designed nozzles at the bottom of the filters. As the air passes up through the filter, the bed of sand is thrown into a state of violent ebullition, so that the particles of sand knock together and free themselves from the dirt adhering to them. A short reversal in the flow of the water then carries away the dirt and discharges it down a waste pipe. The air is admitted from above and forced down a central pipe and along a number of distributing pipes fitted with specially designed nozzles, the arrangement being such that the pressure at all the nozzles is the same.

When first put into service the bath was filled from an open-air sea water bathing pool, which had been standing since the previous season, and when it was full it was impossible to see the tiled bottom in the shallow end. By the opening day, however, after the filtering arrangements had been in operation, the water was, we are informed, in perfect condition.

## IRON AND STEEL DEVELOPMENTS IN AMERICA.

WITH the decreasing resources of rich iron ores in the Lake Superior district, greater attention is being paid to the treatment of the low-grade ores that exist in vast quantities. Experiments are being made with washing, gravity concentration and magnetic concentration. Important improvements have been made also in the sintering of iron ores. Coke made from washed coal and having a low ash content, has effected higher production rates in blast-furnace operations, while further improvement has resulted from sintering the ore charged to the furnaces. A furnace output of 1000 tons of iron daily has been reached, and it is expected that this record will be raised to 1200 tons. Higher efficiency has been attained in cleaning the furnace gases and in using the gases for coke ovens and open-hearth furnaces. Some 50 furnaces are now equipped with mechanical control of combustion. In one case oil, atomised by steam, is mixed with the air. Further experimentation is being made with natural gas in open-hearth furnaces, and also with a mixture of blast-furnace and coke-oven gas. Investigations on the effects of deoxidation and mould conditions on the tensile strength of acid electric-steel castings indicate that ordinary specifications can be met in castings made in either dry-sand or green-sand moulds. A marked increase has been made in the use of the electric furnace for melting cast iron. Temperatures as high as 3200 deg. Fah. were reached, but are considered undesirable, the best results being obtained at temperatures between 2300 deg. and 2600 deg. A low-carbon—2½ to 3 per cent.—high-test cast iron was produced by melting steel scrap in the cupola and adding ferro-alloy to adjust the percentage of manganese and silicon. The use of nickel-chrome cast iron is extending, and a cast iron containing nickel, chromium and copper by means of adding 15 per cent. of monel metal is found to be non-magnetic and non-corrosive.

## Oil-Electric Locomotives for Siam.

DURING the past few years the Diesel-electric railcar and locomotive have emerged from the experimental stage and have proved their value as regards efficiency and economy with reasonable maintenance costs, even under severe conditions, in different parts of the world. Several firms have played an important part in the development work, and Sulzer Brothers, of Winterthur, Switzerland, have an excellent record in this connection. As far back as 1912 this firm built its first Diesel locomotive, but at that time the Diesel-electric principle had not been evolved and a direct drive was relied upon. Latterly, the Diesel-electric system has been developed by this and other firms, and successful locomotives have been in service in various countries for a number of years. In 1930 the Royal State Railways of Siam ordered six 450 B.H.P. oil-electric locomotives from Sulzer Brothers, and the first of these units has recently been completed and has undergone exhaustive trials in Switzerland without any hitch and to the satisfaction of all concerned. The first of the Siamese Sulzer locomotives to be completed is shown in Fig. 1. The locomotives are intended for operation on a metre-gauge line and will work through traffic on the Siamese main lines. They have been built to Sulzer Brothers design, the electrical equipment being supplied by the Ateliers de Construction Oerlikon and the mechanical parts of the locomotives by Henschel und Sohn A.-G., of Cassel.

The principal particulars are as follows :—

| | |
|---|---|
| Gauge | 3ft. 3⅜in. (1 m.) |
| Length over buffers | 44ft. 6⅜in. (13·59 m.) |
| Distance between bogie pivots | 24ft. 3in. (7·4 m.) |
| Wheel base of bogies | 9ft. 10in. (3 m.) |
| Number of driving axles | Four |
| Number of carrying axles | Two |
| Service weight | About 60 tons |
| Minimum adhesion weight | About 43 tons |
| Diameter of driving wheels | 36in. (914 mm.) |
| Diameter of free wheels | 30in. (762 mm.) |
| Type of oil engine | Eight-cylinder, four-stroke cycle |
| Output (continuous) of the engine : | |
| At 700 r.p.m. | 450 B.H.P. |
| At 620 r.p.m. | 400 B.H.P. |
| At 530 r.p.m. | 340 B.H.P. |
| Maximum speed | 37½ miles/h. (60 kilom./h.) |
| Tractive effort, one-hour rating at 12·8 miles per hour (20·5 kiloms. per hour) | 9130 lb. (4150 kilos.) |
| Maximum starting tractive effort | 20,680 lb. (9400 kilos.) |

The frame is formed of deep section longitudinal members adequately cross braced and provided with suitable engine bearers. The draw and buffer gear is fitted on the bogies, which support the main frame on spherical pivots and substantial side bearings. For the purpose of the trials over the Swiss railways, however, a temporary buffer construction had to be employed because the couplings and height of buffers above the track differ from Siamese standards. The body consists of a steel framework covered with sheet metal and the roof over the engine compartment is removable, in order to facilitate overhaul of the oil-electric set. The tanks for fuel and water, and the silencer, are arranged in the roof, where the regulating resistances are also placed and are protected by a removable sheet metal cover. The partitions between the engine compartment and the cabs are of strengthened sheet metal construction. On both sides of the oil engine a double floor is provided, the lower part being

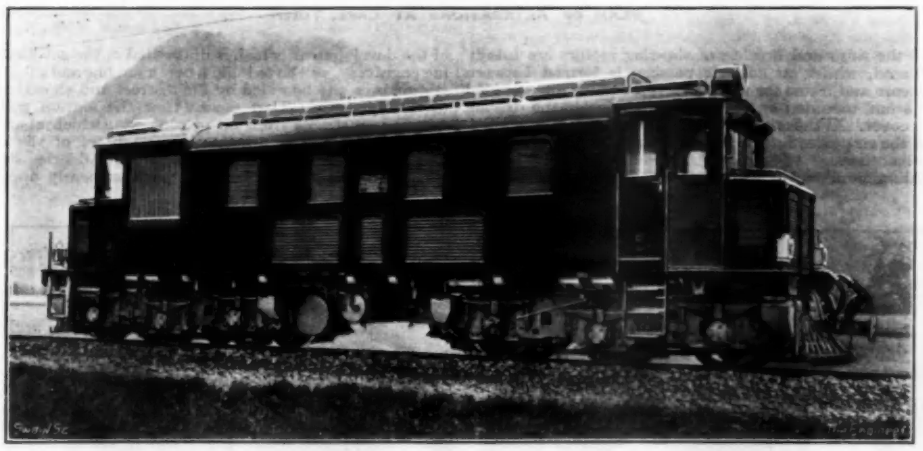


FIG. 1—450 B.H.P. SULZER OIL-ELECTRIC LOCOMOTIVE FOR SIAM

composed of sheet iron and the upper part of teak. The space between them is used for the cables and piping, which are adequately protected, but they are readily accessible.

The prime mover—see Fig. 2—consists of a standard Sulzer locomotive type heavy-oil engine. It has eight cylinders and is of the four-stroke cycle trunk-piston type. The cylinders are cast in two blocks of four, which are bolted together to form a rigid longitudinal girder. The light main frame of the engine is of cast steel and is designed to ensure rigidity. The connecting-rods are of chromium-nickel steel, while the uncooled pistons are of aluminium. By the adoption of these special materials it has been possible to keep down the total weight without sacrificing reliability, and particular attention has been paid to reducing the weight of the moving parts in order to secure vibrationless running. The engine operates with direct airless-injection of fuel on the pre-combustion chamber principle, the pressure necessary for complete atomisation of the fuel being obtained through partial combustion of the fuel in the pre-combustion chamber. This method of injection has the advantage of requiring a comparatively low injection pressure and fairly large nozzle holes. Each cylinder has its own fuel pump, arranged between the push rods of the inlet and exhaust valves of the cylinder, where it is accessible, the pumps being directly driven from the main cam shaft. By means of a centrifugal governor which keeps the engine running at a constant speed, the quantity of fuel is automatically adjusted to suit the required output of the engine, and this simple fuel injection system gives high economy over a wide range of loads. The engine is started by means of the main generator, which is connected to a storage battery and works as a motor during the starting period, so that starting air tanks or starting compressors are not required.

The generator to which the engine is coupled is self-ventilated, a fan mounted on its shaft drawing air through the moving parts. The four traction motors are of the nose suspension type and are also self-ventilated, their torque being transmitted to the axles through reduction

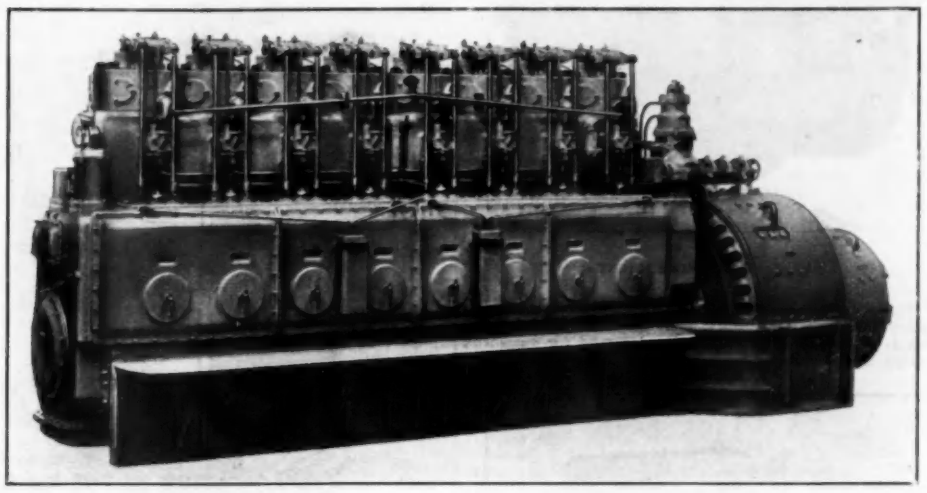


FIG. 2—450 B.H.P. HEAVY-OIL ENGINE COUPLED TO D.C. GENERATOR

gearing. Each motor is equipped with a remote-control contactor and a maximum current relay. By means of a reversing switch which can be operated from the cab electro-pneumatically, the traction motor fields are reversed in order to change the direction of running. The auxiliary generator, which supplies the current for the various auxiliary machines, and the starting battery, and which also serves for exciting the main generator, is rigidly coupled to the main generator. The complete set stands on a common auxiliary frame constructed of steel plate and rolled sectional iron and is directly attached to the locomotive frame. In order that the engine may fully satisfy the conditions of service operation it is designed for three different speeds, which can be set from each cab. The starting and stopping of the engine is also controlled from the cabs. Whenever the locomotive is coasting or standing in a station the engine can be stopped and can be started again within a few seconds, thus effecting a considerable saving of fuel as compared with the practice of running the engine continuously. The cooling water for the engine is circulated through coolers fitted on both sides of the locomotive. Two fans, driven by electric motors, cause air to enter the side walls and pass through the coolers and to leave by way of openings in the roof. By means of field tappings the speed of the fans, and consequently the cooling effect, can be varied. The coolers for the lubricating oil are integral with the water coolers.

The principal circuit connects the main generator to the four series-wound traction motors, which work in parallel, and by means of the controller fitted in each cab resistances arranged between the rotor of the auxiliary generator and the field of the main generator are switched in and out, thus making it possible to change the tractive effort to suit requirements. By means of the simple arrangement of the controls and their gear it is possible for one man to operate the locomotive. The fuel delivery to the engine and its lubrication and cooling are also automatically controlled, so that no special engine attendant is required. The auxiliary machines that have to operate when the locomotive is running with the engine at rest or during halts, such as the motors of the vacuum pump and auxiliary compressor, may also be connected to the accumulators, which are of the iron-nickel type and are situated in the front and rear sections of the locomotive. As soon as the auxiliary generator pressure rises above 130 volts the charging contactor between the auxiliary generator and battery closes the charging circuit automatically, whilst a reverse current relay breaks the circuit when the voltage at the terminals of the auxiliary generator is less than that of the battery.

Since the parallel-connected series motors which drive the cooling fans only have to work when the engine is running, they are connected to the terminals of the auxiliary generator. The cooling water pump is driven by a series motor which comes into service automatically as soon as the engine is started, and when the engine is at rest the cooling water pump may still be kept running by means of a switch fitted in the cab, thus making it possible to continue cooling the oil engine after it has been stopped so as to avoid the possibility of cracked covers, &c. The current for the interior and exterior lighting of the locomotive is supplied by the battery, and the intensity of the searchlight can be varied by means of a dimming resistance.

By means of a controller in each cab the excitation of the main generator may be altered. A switch connected with the speed adjustment of the oil engine is provided for running forwards or backwards, together with a starting and stopping switch. In each cab there is also a switch for the vacuum pump and one for the cooling water pump. The following instruments are arranged so that they can easily be read by the driver :—A tachometer, showing the speed of the engine ; a wattmeter for the output of the main generator ; and an ammeter for the traction motors. By means of the first two instruments the driver can see at a glance if the engine is running normally. If for any reason one or more cylinders should misfire or cut out during service, which may happen owing to failure in the delivery of fuel, the governor will cause the load to be distributed over the other cylinders, which are consequently overloaded. This condition can, however, soon be observed and corrected, as an additional instrument is fitted in the cab to show the lift of the governor, which at once indicates any irregularities in the working of the engine. There is also an indicating device to show if the cooling water and lubricating oil are properly circulating. Another instrument in each cab shows the speed of the locomotive. The locomotive is provided with a vacuum brake and a hand brake, whilst compressed air sanders for all driving wheels and for both directions of running are fitted on the bogies.

The results of the extensive trials to which the locomotive was submitted on the Rhaetic Railways proved entirely satisfactory to the purchasers and the makers of the locomotives. The manœuvring and shunting operations were carried out with ease and smoothness and the train was stopped on the most difficult stretch of the track, *i.e.*, on a gradient of 1 in 37 and with curves of 100 m. radius. The time for the acceleration from stop to 19 miles per hour was 30–35 seconds. The fuel consumption was 0·035 lb. per ton-mile, based on the gross weight of the train, including the weight of the locomotive. At the present time locomotive engines represent one of the most important branches of Sulzer Brothers Diesel engine manufacturing business. Locomotive engines representing something like 15,000 B.H.P. are under construction in the shops at Winterthur, some of the sets being for locomotives of over 1500 B.H.P.

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COMMERCIAL hot-rolled stainless iron has a brown surface. Similar iron annealed in the laboratory furnace and either allowed to cool with the furnace or pushed into the cooling chamber comes out a dark green colour. In other words, where there is ample oxygen the iron oxide gives the predominating colour, but where the supply of oxygen is limited, as in the hydrogen atmosphere, the chromium, being more active toward oxygen than either hydrogen or iron at the annealing temperature, takes all of the oxygen and gives the iron the predominating green of chromic oxide. This is true whether the steel is slowly cooled or pushed quickly into the cooling chamber. In fact, the chromium oxidises at a temperature at which iron oxide could not exist, and forms a protective oxidised layer of chromic oxide over the iron just underneath. It is possible to reduce the dark brown oxide on a hot-rolled stainless iron sheet in the laboratory furnace without any special precautions. The surface seems to be composed mainly of iron oxide due to some selective oxidation.

## Enclosed Electric Motors.

There are many conditions under which the ordinary open type of electric motor cannot be used, and during a recent visit to the Lancashire Dynamo Motor Company's works at Trafford Park, Manchester, two motors designed

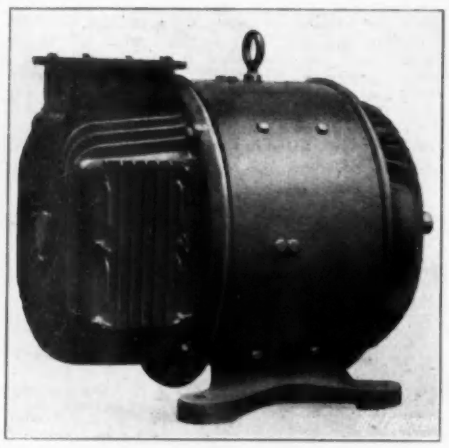


FIG. 1—GASWORKS MOTOR

to meet adverse conditions were brought to our notice. One of them is the totally enclosed machine shown in Fig. 1, which, although primarily designed for gasworks service, is also suitable for operation in other industries in

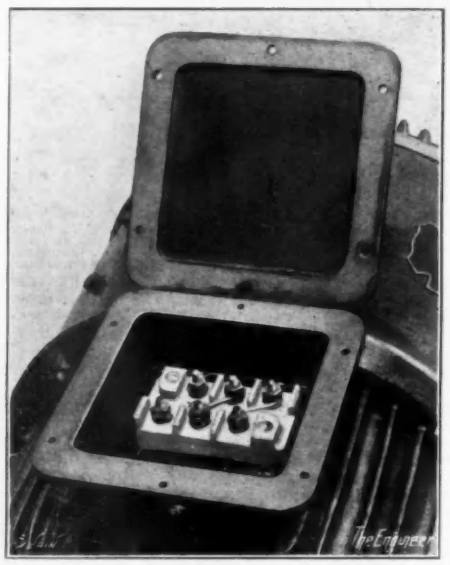


FIG. 2—TERMINAL BOX

which acid fumes, &c., are met with. From the illustration it will be perceived that all the internal parts are completely enclosed, and that additional radiating surfaces have been provided to get rid of the heat. The end cover at the driving end is cast solid and is absolutely dust-tight. In the case of squirrel-cage motors and slip-ring motors fitted with external slip rings a similar cover is fitted at the opposite end, and in the latter instance the slip rings are enclosed in a flame-proof case. D.C. motors and slip-ring machines having internal slip rings have a heavy cast iron end plate, and the inspection openings for the commutator or slip rings are provided with wide machined flanges on to which heavy cast iron plates are bolted. Ball and roller bearings with dust excluders are fitted, and cable attachments, &c., are supplied to specification. All machines are designed for a temperature rise not exceeding 50 deg. Cent., on continuous rating in accordance with the B.E.S.A. specification 168/1926. Special terminal boxes—see Fig. 2—giving adequate protection, are provided, and cables from the interior of the motor are brought through insulation permanently cemented in position. A solid cast cover, with wide machined flanges, is bolted to the top of the terminal box. To carry a sealing chamber, armour clamps, or a conduit plate, a similar plate is provided to meet requirements. Special precautions are taken to render the insulation impervious to chemical fumes.

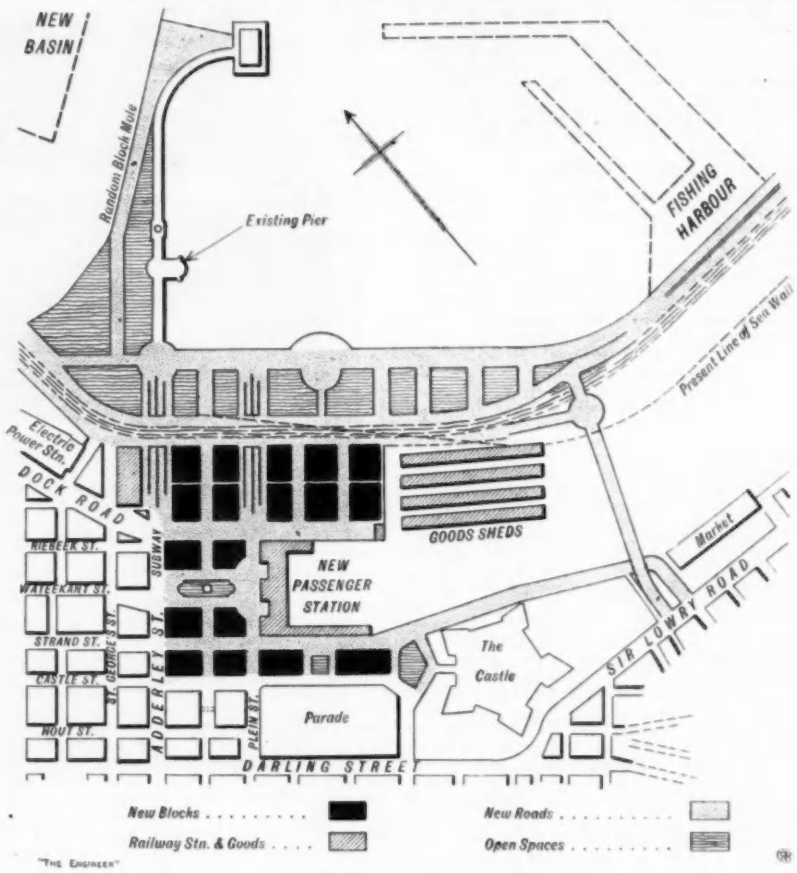
The other motor is a totally enclosed frame-cooled machine, known as the "Tefco" motor, and is shown in Figs. 3 and 4. It is a standard Lancashire squirrel-cage or slip-ring machine, fitted with internal end shields and special end covers by means of which the windings and the rings and brushes of slip-ring motors are totally enclosed, whilst an annular passage is formed between the core and frame for the passage of cooling air provided by a fan, mounted on the motor shaft inside the driving end cover. At the other end there are air orifices, as shown, and the air passes outside the coil from one end of the motor to the other.

Aluminium end shields are attached to the ends of the stator core, and extend over the windings. On the innder side of each end cover there is a machined tapered ring, and when the end covers of the aluminium shields are bolted in position, the ends of the shields are forced within the tapered rings, making firm and tight joints. This simple and strong construction, whilst isolating the windings from the outside atmosphere, also forms an annular passage between the core and frame and through this passage a high-speed current of air is continuously driven by the fan. An economical and efficient motor, which is suitable for operation in places where dust, grit, dirt, water or fumes are present, is thus obtained.

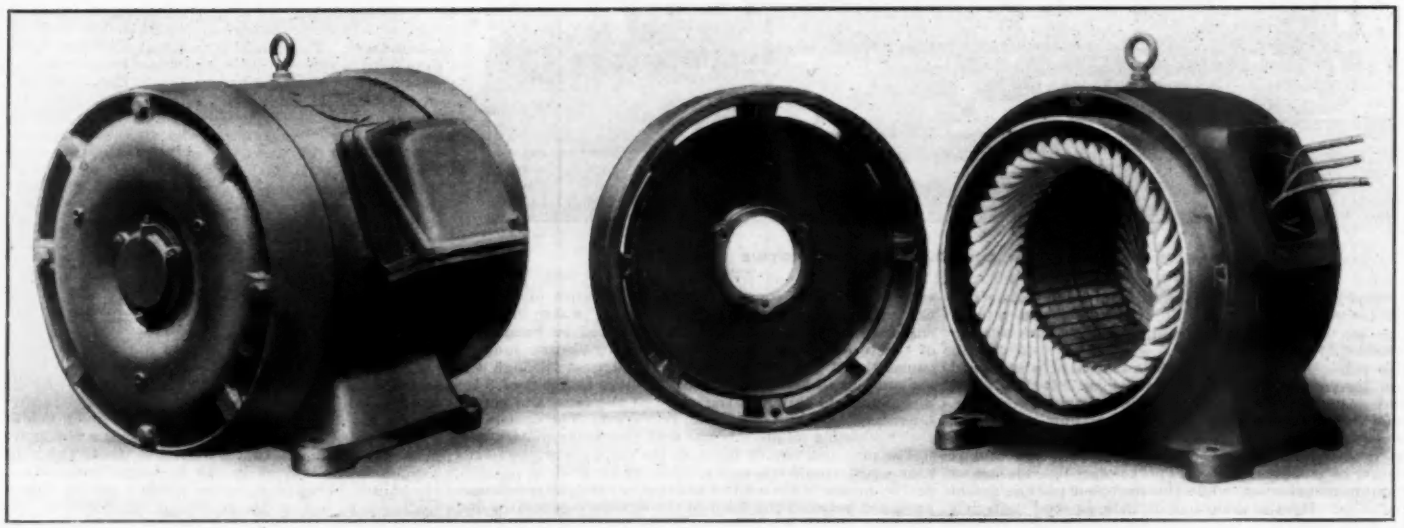
## South African Engineering Notes.

### Big Cape Town Scheme.

A very large development scheme which will completely change the appearance of Cape Town was begun on June 25th, when representatives of the Railway Administration and of the City Council signed an agreement to spend £2,333,000 on developing the foreshore of the city and other works. In broad outline the object of the development, which is illustrated in the accompanying engraving, will be to build a new main line and suburban station on a site bounded by Plein-street and an extension of Strand-street. That means that the station will be moved two streets from its present site, which abuts on Adderley-street, the principal thoroughfare of the city. The goods yard, which also abuts on Adderley-street, will be moved still further to a position nearly opposite




PLAN OF ALTERATIONS AT CAPE TOWN



FIGS. 3 AND 4—"TEFCO" TOTALLY-ENCLOSED VENTILATED MOTOR

the old castle. The effect of these movements will be to make available for sale thirteen blocks of land of approximately 531,000 square feet in area. A new traffic artery will be provided by the extension of Strand-street below the Castle, joining Sir Lowry-road at Tennant-street. At present, the suburban electric railway runs

along the area that will be occupied by this road. Another important development is the reclamation of ground all along the Table Bay side of the docks railway to a distance of about 500ft. Plein-street will be extended to the foreshore, and that street and Adderley-street will be led under the docks railway by subways. The docks railway will be moved nearer the bay. To prevent the foreshore from being spoiled, it is agreed that for 20 years no permanent buildings shall be erected on the land between the new position of the docks line of railway and the sea, which may be used as recreation grounds and gardens. The pier at the foot of Adderley-street will be extended about 1200ft., and will bend from the new docks basin towards Woodstock. At its end there is to be large concert hall. The new esplanade will carry a double road, one for fast and the other for heavy traffic.

### Oil from South African Coal.

The official organ of the Union Government states that definite proposals have been made to the Government in regard to the distillation of oil from South African coal. The plans of the company which has a backing of £2,000,000, cover the erection of a factory for the manufacture of oil from coal and torbanite—the latter is abundant in the district of Ermelo—in one of the coal centres. If the negotiations with the Government are successful, a company will be formed immediately. Should the plan mature—and the official organ expresses the conviction that it will—at least 1000 whites will be employed. The undertaking will have the additional advantage to the country in that important subsidiary industries will be established for the manufacture of by-products, and the steel industry will be benefited, because the new company will require a large number of steel drums. The experiments made with South African coal have had very satisfactory results.

### Railway Earnings.

For the week ended June 20th the railway earnings were :—Passengers, £103,672 ; parcels, £15,263 ; goods, £246,553 ; coal, £61,316 ; livestock, £10,988 ; rents and miscellaneous, £12,896 ; total, £450,688, as against £487,925 for the corresponding week in 1930. The total to that date from April 1st, 1931, is £4,988,988, compared with £5,392,821 for the corresponding period last year. Cuts in overtime, piecework and other rates, also economies in various directions, such as making uniforms last longer, are understood to be effecting considerable savings.

### Limpopo Valley Line.

The survey for a railway from Magude on the Kinavane line to the Limpopo has been completed. The line will be about 90 miles long, and for some 40 miles will traverse the fertile Limpopo Valley, the development of which is its object. The Portuguese Government (Mozambique) hopes eventually to promote big settlement schemes in that area.

### Natal Railway Electrification.

In order to supply the current for the Maritzburg-Durban electric railway—Natal main line—a new sub-station is to be built at a convenient centre between Maritzburg and Cato Ridge. It will consist of two 2000-kW motor generators similar to those already installed in the other sub-stations on the existing electrification. Excellent progress is being made with the extension of the main line electrification, and it is anticipated that the transformation of this 28-mile section of the line from Maritzburg to Cato Ridge will be completed within eight or nine months. Two hundred miles of continuous electrified line will then be in use between Glencoe Junction and Cato Ridge. Four years ago consulting engineers retained by the Administration estimated the cost of electrifying the Maritzburg-Cato Ridge section at over £300,000, as compared with the Administration's present estimate of approximately £150,000, the work being done by the Electricity Supply Commission and the Railway Administration.

### Petrol from Coal.

The production of petrol and oil from coal and torbanite is the object of a company which had just been registered at Pretoria with a nominal capital of £300,000. The inventor of the process which is to be used is Mr. William Mauss, of Johannesburg, who sold the rights in it to the Industrial and Mining Developments Prop., Ltd., and he is to have the post of technical adviser and consulting engineer at a salary of £1800 a year and also a royalty of halfpenny for every ton of coal, shale or torbanite employed for the purpose of petrol or oil extraction. The company has purchased options for mining and prospecting on certain farms in the Ermelo district, where the main works are to be situated. A pilot plant which has already been erected in Johannesburg for experimental purposes is to be taken over by the company.

### Buluwayo's Power Supply.

Buluwayo has made remarkable progress with its electrical undertaking in recent years. With the completion of the present extensions the total capacity will be 8000 kW., while the population is only 8500. A new power station was commissioned in 1926, but almost immediately the growth of the load pointed to the need for early extensions. The next stage was the installation of a 2000-kW set and the boiler plant was extended. The present extensions comprise one 4000-kW Bellias and Morcom turbine with a speed of 3000 revolutions per minute, coupled to a British G.E.C. alternator with a continuous maximum rating of 4000 kW at a power factor of 75 per cent. and an approximate regulation of 15 per cent. to 18 per cent. as unity power factor. The condensing plant is of the " contra-flow " surface type, with 8000 square feet of cooling surface. The original station had four Babcock and Wilcox boilers, each rated at 11,000 lb. of steam per hour at 200 lb. per square inch and a total temperature of 600 deg. Fah. natural draught, and two Green's economisers in parallel in the main flues. Two further Babcock and Wilcox boilers have now been installed, each of which has a rating of 22,000 lb. of steam per hour normally and 24,000 lb. per hour as a maximum at a gauge pressure of 200 lb. per square inch when fed with water at a temperature of 100 deg. Fah. and fired with Wankie coal having a calorific value of 12,500 B.Th.U. per pound. The extensions include one 20-ton engine-room crane. The installation, &c., of the new plant has been under the supervision of the Town Electrical Engineer, Mr. F. H. Taylor.

### Railway Estimates.

The estimates of expenditure on capital and betterment works in connection with the South African Railways and Harbours for the year ending March 31st, 1932, disclose a total of some £3,564,000, made up as follows :—Construction of railways, £152,340 ; new works on open lines, £2,174,475 ; rolling stock, £309,409 ; harbours, £566,980 ; unforeseen works, £250,000 ; working capital, £110,771. The construction programme of 1931 comprises a loopline from Kleinstraat to Matroosberg to cost £115,908 ; an extension from Northam to Kwaggashoek, a distance of 28 miles—for the conveyance of iron ore to the new steel works at Pretoria—at a cost of £140,140, and a line at Durban connecting the point with Congella *viâ* the foreshore, to cost £183,454. The amounts voted for the current year in respect of these three undertakings are £60,000, £10,000 and £9000 respectively.

### Big Mine Blaze.

A disastrous fire, which followed an explosion in the winding engine house of the west shaft of the West Rand Consolidated Mine, on June 30th, destroyed all the machinery and electrical apparatus in the building. As a result of the fire all work on the shaft has been stopped, and it is reported that it will be some time before normal operations can be resumed. The total damage from fire is estimated at over £25,000, but as the shaft has been put out of action the total loss entailed will be very much heavier.

## Provincial Letters.

### THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

### Midsummer Vacation.

THE week has been one of industrial idleness, practically all the Midland and Staffordshire works having been closed down for the August holidays. In years of normal trade many of the establishments in this district have resumed operations at mid-week, but so widespread and severe is the trade depression that industrialists have been glad of the opportunity to lay plants idle for a full week, and in some cases in the hope that some accumulation of orders would enable them to recommence with a greater chance of putting their machinery to better use than has been the case of late. The prospects of any real reserve of orders being built up during the stoppage are not encouraging, and it is significant that prior to the closure there was no pressure for deliveries of raw materials. The output from the furnaces during the current week has gone to swell stocks, which in many cases were unwieldy enough without this addition. The first six months of the year have been lean and unsatisfactory, and inquiries as to the chances of an improvement over the remaining portion of the year do not meet with a cheerful reception. Engineers, manufacturers and industrialists generally are befogged. They can see no tangible evidences of an early revival in trade, and though they all hope for a development of the usual autumn trade, few are sanguine enough to anticipate it. Transactions in iron and steel this week have been few indeed, and the week might well be written off as unproductive and unprofitable.

### Iron Prices Reaffirmed.

Consumers of pig iron in this area were not surprised at the action of the Central Pig Iron Producers' Association in reaffirming the recent selling rates. The position has changed hardly at all since the concession granted in May, and with output at so low an ebb it was hardly to be expected that smelters would see their way to cut their profits further. Indeed, there are blast-furnacemen in this district who declare that the margin of profit on current transactions is so small as to be almost negligible, and this despite exceptionally low fuel costs. If there were any prospect of a lowering of prices stimulating consumptive demand, the matter might be looked upon differently, but reports from founders and forgemen are far from encouraging. Work is scarce in both branches, and little hope is entertained that larger quantities of raw material will be absorbed, at any rate for some little time to come. Current orders are of very small dimensions, and are usually accompanied by a request for almost immediate delivery. Just prior to the holidays one or two Midland blast-furnacemen asserted that they had experienced some improvement in demand, but it is certain that if there is any expansion of trade in raw iron, it is not of a general character. Though pig iron prices are maintained in this area by agreement with the Association, in northern markets Northamptonshire smelters are able to sell at lower rates, and judging by reports from Cleveland they are meeting with no mean success. This business is of considerable advantage to district furnaces, in that it enables them to keep down stocks. Derbyshire furnacemen still find an outlet for a considerable portion of their production in the pipe foundries. The prices of Midland brands of iron, as reaffirmed by the Association, are :—Northamptonshire : Forge, £2 17s. 6d.; No. 1 foundry, £3 5s. 6d.; No. 2, £3 4s. 6d.; No. 3, £3 2s. 6d.; No. 4, £3 1s. 6d. Derbyshire : Forge, £3 1s.; No. 1 foundry, £3 9s.; No. 2, £3 8s.; No. 3, £3 6s.; No. 4, £3 5s.—delivered at stations in the Black Country and subject to rebate.

### Steel.

Demand for heavy steel is restricted to small orders, structural engineers' present requirements being on a minute scale. In the Midland bridge and constructional yards, there is little work on hand, and there appears to be no signs of big developments in the immediate future. The main portion of the bridge work is dependent upon the development and reconstruction of railways, and on financial grounds only absolutely necessary work is being put in hand. The constructional work on hand has mostly to do with towers for the "grid" system, and steel framework for the building trade. As there is little new work coming into the Birmingham rolling stock establishments, this industry is not absorbing the quantity of steel it does in normal times. The general engineering trades also are calling for but small tonnages of steel, activity being at a low level. In the electrical section, where business has been relatively good, there has recently been signs of a falling off, and though improvement in the lighter branches is anticipated, the same cannot be said for the heavy departments. Values of finished steel remain at the level fixed by the associated makers. Angles are £8 7s. 6d., less 15s. rebate ; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; and ship, bridge and tank plates, £8 17s. 6d., less 15s. Boiler plates sell at £9. Re-rollers and producers of semis are doing very little business. Competition from the Continent remains as keen as ever, and it is only by cutting prices that local producers can secure sufficient business to keep the mills going. For small bars re-rolled from foreign billets, as low as £6 7s. 6d. per ton is accepted, while all-British bars are quoted £7. Mild steel billets are £5 upwards, and Staffordshire hoops £9 10s.

### Manufactured Iron.

Business is still falling away in the Staffordshire finished iron trade, and the output for May and June, as disclosed by the bi-monthly ascertainment of the Midland Iron and Steel Wages Board, showed a shrinkage when compared with the preceding two months. Following the reduction of 10s. per ton in the selling price of marked bars in April, the ascertainment discloses that there was a sufficient fall in selling prices of finished iron to carry a reduction of 2½ per cent. in ironworkers' wages, and this took effect on Monday last. So poor are order books that it is a matter for conjecture when some of the mills will resume after the August break. In practically all instances there will be a full week's idleness, and it seems likely that in some instances the holidays may be extended to ten days or a fortnight. Marked bar makers are, as they have been for at least twelve months past, the more fortunate amongst ironmasters, as far as the volume of work available is concerned. Crown and common bar producers are very badly situated, and with competition severe they are often forced to accept business at unremunerative rates in order to keep the mills operating. Makers from other areas competing in the Midland market offer supplies at rates which Staffordshire makers, who produce a superior class of bar, have difficulty in combating. Nut and bolt and fencing bars have been almost forced off the market by the cheap material sent here from Belgium, which material meets the needs of local manufacturers, though they admit its inferiority. The market for iron strip shows some improvement, but up to now makers have had to be content with the late selling price of £10 12s. 6d., though this is considered to be so low that they will undoubtedly take the first available opportunity of improving upon it.

### Galvanised Sheets.

There are one or two sheet manufacturing firms so well placed for orders that the holiday suspension will last not more than a day or two. Unfortunately, that is not the general experience, and many mills will be closed all next week. Some sellers are holding out for better selling prices, but the market is disinclined to pay more than the figure recently ruling. Though makers are quoting £9 10s. to £9 12s. 6d., business can still be placed at £9 7s. 6d. f.o.b.

### Coventry Bridge Completed.

Lockhurst-lane Bridge, Foleshill, constructed at a cost of £55,000 by the Coventry Corporation to replace the level crossing over the London, Midland and Scottish Railway at Foleshill Station, was opened on July 30th by the Mayor of Coventry. The cost of the bridge itself, which was commenced in November, 1929, was £21,054, and it was constructed by Messrs. Kedley and Son, of Coventry. The bridge and its approaches are of reinforced concrete construction, 2200 cubic yards of concrete and 430 tons of steel having been used. Its overall length is 927ft., and it has a width between the parapets of 45ft., with a 30ft. carriageway and two footpaths.

### LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER.

### Textile Machinists Agreed.

THE textile machinery merger scheme, under which six of the leading Lancashire firms in this branch of engineering agree to pool their interests, is, or shortly will be, a *fait accompli*. So much was indicated by Sir Amos Nelson, who presided at the annual meeting in Manchester on Monday of Brooks and Doxey, Ltd., one of the six concerns affected. Sir Amos stated that the scheme itself has been virtually agreed upon, and only minor details remain to be settled. Delay through various causes has been responsible for a postponement of the scheme coming into operation. Originally, it was planned that a beginning under the new *régime* would be made at the end of last March, but it is now proposed to operate from the end of next month. Largely through economies in the production and distribution costs, the boards of directors of the constituent companies are hopeful that the first trading period will show improved results. Meanwhile, prospects of substantial sales of textile machinery

in the home market seem to get no brighter. Much of the existing plant in Lancashire mills is regarded as redundant, and the effects of the policy of scrapping are widespread. It is obvious, in the first place, that opportunities in the home market for sales of new machinery are few, whilst the fact that a good proportion of the discarded plant is in excellent condition, and is finding outlets abroad adds to textile machinists' difficulties in foreign countries. That which is not marketable intact is being disposed of to foundries as scrap; this, in turn, as Midland ironmasters have learned to their cost during the past six months, has materially reduced the demand for pig iron in this part of the country.

**Coal Research Headquarters.**

It is expected that the official opening of the new research headquarters in Park-street, Manchester, of the Lancashire and Cheshire Coal Research Association will coincide with the annual conference of the Institute of Mining Engineers, to be held in Manchester at the end of next month. Hitherto the research work of the Association has been carried out in the laboratories of the Manchester College of Technology.

**Constructional Engineering.**

The difficulties of Lancashire constructional engineering firms are reflected in the annual report of Edward Wood and Co., Ltd., of the Ocean Ironworks, Trafford Park, Manchester, in which reference is made to the reduced turnover and the necessity of cutting prices to secure orders. Compared with a net profit of £20,187 last year and one of £21,711 in 1929, a trading loss of £7158 has been sustained in the twelve months to the end of May last. The Trafford-road Bridge, Salford, which spans the Manchester Ship Canal, is to be closed at midnight on August 12th–13th for reconstruction. For a period of about six months, traffic between Stretford and Salford will be diverted over Regent Bridge or Barton Bridge. A temporary footbridge at Trafford-road is to be made available for pedestrians. Joseph Parks and Son, Northwich, has secured the order for the construction of a 250ft. span swing bridge over the river Weaver at Acton Bridge for the Weaver Navigation Trustees. The bridge is to form part of the improvement of the Whitchurch–Warrington road by the Cheshire County Council, and it is stated that British steel will be used throughout the construction.

**Personal.**

Mr. L. Holme Lewis, the Manchester City Water Engineer, who is to retire under the age limit, will be succeeded by Mr. W. H. F. Creger, at present deputy engineer. Mr. Holme Lewis, however, is to remain as engineer-in-charge of the first section of the Haweswater scheme which is now in progress.

**Non-ferrous Metals.**

Of the non-ferrous metals, tin has been the only section to register any recovery during the past week, all the other metals sustaining slight losses on balance compared with the previous week. In few instances, however, has business shown any improvement. For the third successive week copper has lost ground, although only to the extent of 5s. a ton. This, however, brings current prices down to a new "low," and with the copper-using industries the world over only very moderately employed, the demand continues poor. In respect of tin, it is understood that the Welsh tin-plate trade has been a somewhat more active buyer, but the call for the metal on the Continent and also in the United States is at a low ebb. Under the circumstances it is noteworthy that prices have advanced by rather more than £2 a ton, thus wiping out the loss of the previous week. Interest in spelter has been very moderate, and there has been a further decline in values of about 7s. 6d. a ton. Current prices, however, are still appreciably above the lowest point touched at the beginning of June. Lead is again 5s. cheaper, and a quiet business has been done during the past week.

**Iron and Steel.**

Lancashire trade in iron and steel, poor as it has been for some time, has been disorganised this week by the closing down of a number of consuming works in various parts, including Manchester, for extended holidays. Trade in foundry iron has been very small indeed, although Midland makers report having received a number of small orders in the closing days of last month. Altogether, however, business in this section has been of a very retail character. There has been no change in values, Derbyshire, Staffordshire, and North-East Coast brands of No. 3 being quoted at 67s. per ton, delivered Manchester or equal, Northamptonshire at 65s. 6d., Scottish at from 87s. to 87s. 6d., and West Coast hematite at about 81s. Bar iron has attracted little attention, but prices keep up at £9 15s. for Lancashire Crown bars and £8 5s. for No. 2 material. There has been a marked absence of contract buying in the steel section, and the limited trade that has been done this week has been made up of specifications for small quantities against early rolling programmes, constructional engineers, boiler makers, and locomotive builders, all pursuing this policy. Acid and basic boiler plates are quoted at about £9 per ton, general plates at £8 17s. 6d., sections at £8 7s. 6d., joists at £8 15s., large bars at £9 7s. 6d., and small re-rolled bars at about £6 10s.

BARROW-IN-FURNESS.

**Hematite.**

Quite apart from a slackness which generally sets in during the holidays, the hematite pig iron market is listless. There is no life in it, nor is it anticipated that there will be any immediate noticeable improvement. The demand continues to be very light, and it is quite apparent that buyers are not inclined to enter the market with a view to securing a good stock of pig iron at a price which is admittedly below cost. Stocks in some cases are coming down, and there is no talk of a further restriction of output. Some furnaces may go out, but if they do others will be restarted, and the old ones will undergo their periodical overhaul. At Barrow the furnaces are still damped down, but there is just a possibility of there being more activity in a few weeks. American and foreign orders are scarce. The native iron ore trade is very quiet. Local demands are low and outside business is dull. Foreign ore is not wanted in heavy tonnage at present, and imports are considerably down on last year's figures. The steel market continues to show little life. There are a few orders about and sufficient contracts may be secured to restart the rail mills at Barrow very shortly. The hoop and small section mills are better circumstanced. Workington is still engaged upon railway material, and this is an important factor as regards the absorption of the iron produced there. Shipping is very quiet, and some large cargo steamers have been laid up here for over twelve months.

## SHEFFIELD.

*(From our own Correspondent.)*

**More Open-hearth Activity.**

HOLIDAY conditions have greatly reduced the amount of activity in the Sheffield trades during the past week. The manufacturing departments, particularly those devoted to lighter steel products, have done little, some of them having been closed for the whole week, and others for two or three days. On the lighter side, the stoppage is longer than usual. There has lately been a little more briskness in open-hearth steel production, but there is no sign of any revival of forward buying, and the number of furnaces in commission remains lamentably low. Work at the Park Gate and Lincolnshire plate mills has increased. In steel sheets, however, the depression remains as acute as ever. The railway and shipbuilding steel departments are very badly off for work. On all hands there are complaints of the poverty of inquiries, and there is nothing to indicate a revival of buying. The market in steel scrap is very quiet, as deliveries have been suspended until further notice.

**Departmental Details.**

The demand for heat-resisting steel is well maintained, and a large volume of stainless steel is also being turned out, although competition, both at home and abroad, is increasing. In acid-resisting steels, for chemical work, production is on a good scale, but has not shown much progress of late. There is no new feature in the motor car trade. The builders of such vehicles are still taking good quantities of Sheffield forgings, pressings, stampings, and alloy steel for wearing parts, but all quantities are considerably down, compared with what they were a few years ago. There is acute depression in the export trade in Sheffield's superior tool steels, and the shrinkage continues. The demand for engineers' tools, from the home market, is moderate. The file trade, which has been poorly placed for work for a considerable time, shows some improvement. This, however, is not general, but is confined to a few firms which have special orders on hand from Russia and China. Work from ordinary sources is as limited as before. Enterprising makers are designing special types of files suitable for work on new materials, which have been developed in recent years. Business in ferro-alloys for special steel-making is practically at a standstill, consumers showing little inclination to order anything.

**Trade with the United States.**

A fall in trade with the United States has to be recorded, Sheffield's exports of steel material to that market for the last quarter being much less than half the value of those during the corresponding quarter of last year. The actual figures were £13,000, as compared with £31,000. In cutlery, the fall was from £6400 to £2200, but in safety razor blades there was an advance from £400 to more than £1000. In the corresponding quarter of 1930 safety blade blanks to the value of £5000 were exported, but there has been no trade of this class for more than six months. Exports of all descriptions from the Sheffield district, which includes Nottingham, declined from nearly £200,000 to £160,000.

**Cutlery and Plate.**

There is no improvement to report in the cutlery and plate branches, which are receiving little or no benefit, in the way of improved demand, from the summer season. Large quantities of silver spoons and forks have been bought, since raw silver became so cheap, but there is no similar report to make with regard to silver pieces and ware. It is declared that the cheapness of silver has actually discouraged the buying of such goods by the wealthier classes, who now attach less value to silver because its possession is less exclusive. A movement is on foot for forming a rationalisation scheme among several well-known cutlery firms in the city. It has not reached a very forward stage yet, but it is believed to be necessary, in view of the depression in trade and the lapsing of the Safeguarding Duty on imported cutlery. It is considered probable that if the scheme becomes effective, it will necessitate new buildings and plant, but none of the names of the houses concerned would disappear.

**Thorncliffe Work for Russia.**

Important work for Russia is just now being completed by Newton, Chambers and Co., Ltd., of Thorncliffe Ironworks, near Sheffield. They are constructing a large semi water-gas plant, which will finally be erected at a chemical works at Bobriki, 20 miles south of Moscow. It is anticipated that about twenty or thirty skilled men will be sent to Russia to supervise the erection. The firm is also completing certain classes of blast-furnace work for a Russian establishment.

**Electric Refuse Collectors.**

The Sheffield Corporation has been the first authority in the country to acquire the latest types of electric refuse-collecting vehicles, which were exhibited and demonstrated before delegates attending the International Conference on Public Cleansing at Olympia last week. Two of the vehicles have been obtained, and, together with the necessary batteries and containers, they have cost £1850 each. They are intended for use at present on the various housing estates of the Corporation. It is confidently anticipated that they will do the work of four electric vehicles of the existing type, each machine being capable of dealing with 4500 bins per week. Both are electrically propelled, and exclusive features claimed for them are low loading line, good manœuvrability, and excellent braking power. Two types of containers have been chosen, each fitted with automatic shutters, ensuring dust-free transference of the refuse from the bin to body. One type is the Faun and the other the Neuey.

**Big Quarrying Operation.**

The Cowdale Quarry, near Buxton, has been the scene of one of those great blasting operations which are periodically carried out by the Buxton Lime Firms, Ltd.—a branch of Imperial Chemical Industries, Ltd.—for the purpose of obtaining stone which would otherwise probably take years to get. For weeks quarrymen had been working night and day boring two tunnels at the base of a 70-foot quarry face in zigzag fashion, and in them were stored no less than 6 tons of black gunpowder, before the entrances were blocked with stone. The effect of the explosion was that a huge solid mass of stone rose momentarily, and then crumbled into thousands of pieces, some of which weighed 50 tons each. Altogether, 60,000 tons of stone were displaced.

**Leeds and the Humber Bridge.**

Fears that the trade of Leeds and the West Riding will suffer seriously if the proposed bridge over the Humber interferes with the port of Goole were expressed at a meeting of the Council of Leeds Chamber of Commerce last week. On the suggestion of Sir John Eaglesome, it was decided, in lieu of opposing the Bill by petition in the House of Lords, to pass a resolution strongly objecting to the construction of the proposed bridge unless suitable walls for training the Upper Humber, in order to preserve the navigation to the port of Goole, were constructed in anticipation of or simultaneously with the bridge; and Mr. T. F. Braime was authorised to give evidence against the Bill before the House of Lords Committee. Mr. Braime said that if the port of Goole was destroyed they stood to lose very heavily in Leeds and the West Riding towns. If it was going to cost 1s. 4d. a ton more to ship coal from Hull than it did from Goole, the prosperity of the West Yorkshire coalfield was going to be jeopardised. Hundreds of thousands of tons of coal were sold to the Continent from the West Yorkshire coalfield on a margin of coppers a ton, and not shillings. Therefore, anything which was liable to cause injury to the port of Goole was going to injure the West Riding generally. Proper training walls might avert the danger.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

**Dwindling Exports.**

A CONTINUOUS contraction in the exports of iron and steel from the Cleveland district is giving rise to grave apprehensions. There are fears as to whether it will be possible much longer to maintain the present restricted output. Altogether, conditions are unsatisfactory and discouraging, and, unfortunately, there is little prospect of any improvement. Cleveland pig iron producers have been shut out of many markets by the keen competition from other quarters, and that is reflected in the fact that during July only 2831 tons of pig iron were shipped to foreign destinations, as compared with 3601 tons in June and 4031 tons in May. Denmark was the chief customer for pig iron with 970 tons, while Japan took 480 tons, Belgium 405 tons, and Germany 380 tons. Shipments to Scotland for the month totalled 3238 tons, and 3872 tons were sent to other coast ports. The exports to all quarters totalled 10,151 tons, as against 12,038 tons in July and 11,816 tons in May. The substantial steel rail orders for South Africa have now almost been completed, and whereas over 30,000 tons were despatched during the preceding two months, only 2039 tons were exported to the Union during July. The finished iron and steel shipments for the month totalled 32,842 tons, comprising 3889 tons of manufactured iron and 28,953 tons of steel. In June 39,138 tons were exported. Of the July shipments, 18,417 tons went to coast ports, principally to London, and of the foreign exports 3744 tons were sent to India, 2630 tons to Portuguese East Africa, 1144 tons to Japan, and 929 tons to Rhodesia.

**Coal Trade Proceeds and Wages.**

There has been an amazing drop in the ascertainment figures regarding the Northumberland coal trade in June, which nominally govern wages in August, as compared with May. In May the ascertainment showed that, but for the operation of the minimum percentage the figure would have been 16·25 per cent. above the basis, but the June figure is 3·66 per cent. That means, with the Northumberland minimum percentage at 40, that the owners have a deficit of 36·34 per cent. to make up. The Durham coal ascertainment, on the other hand, shows surprisingly little difference from the ascertainment in May. The economic yield for June is 31·93 per cent., the owners having to make up the minimum wage percentage of 65 by the difference—33·07 per cent.

**Cleveland Iron Trade.**

As is usual at this period of the year, market conditions are extremely quiet, and there is little disposition to transact business. Buyers are still disinclined to negotiate for supplies except to cover early needs. Restricted make of pig iron is rather more than ample, and slow but

steady increase of stocks is taking place, though ironmasters point out that little additional call for iron is needed to necessitate withdrawals from accumulations at the blast-furnaces. Midland iron is still coming forward for consumption in this district, but little buying from that quarter is now reported. Makers are pressing sales of Cleveland iron on firms in Scotland at rates substantially below the fixed minimum figures for the home trade, but continue to be undersold there by dealers in oversea iron. Merchants have little opportunity to put business through, as Cleveland ironmasters are supplying direct requirements of principal home consumers. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d. and No. 4 forge 57s.

### Hematite Pig Iron.

A slightly improved demand for East Coast hematite pig iron is reported, makers having sold parcels to consumers in the Sheffield district. Terms of sale vary somewhat after individual bargaining, but producers are not disposed to name below 61s. 6d. for ordinary qualities and 62s. for No. 1 quality.

### Ironmaking Materials.

The foreign ore trade is at a standstill, and best Rubio ore is nominal at 14s. 6d. c.i.f. Tees. Sellers of blast-furnace coke are inclined to take a firmer stand, but consumers claim they can still get good average qualities at 15s. delivered at the works.

### Manufactured Iron and Steel.

Manufactured iron and steel quotations are upheld, though orders for most descriptions of material are urgently needed. Departments engaged on the production of constructional steel are, however, fairly busy.

### The Coal Trade.

Under some curtailment of output owing to holiday interruptions and a fair volume of tonnage stemmed for early shipment, the general tone of the Northern coal market is steadier, many fitters reporting a favourable turn book well into next week. Northumberland steams offer sparingly, being quoted fully steady at 13s. 6d for the whole of the month. Tyne prices are also steady in tone at 12s. 9d. There is, however, no lack of supplies for the middle of the month or later shipping dates. Stocks of small coal are heavy, with sellers quoting best Northumberlands at 8s. 6d. and Tyne specials at 9s. For all August bunker coals are in request, and the favourite grades offer sparingly, being firmly held at 13s. 6d. to 13s. 9d. Secondary bunkers, however, are plentiful and easy at 13s. There is no improvement to record in other Durham qualities. Gas coal of all descriptions is abundant and just steady. Best kinds are quoted at 14s. 6d., secondary at 13s. 6d., and coking unscreened at 13s. 3d. Patent oven coke is well booked up, and the general production is well absorbed; but there is very little call on the large accumulated stocks. Prices rule very steady at 15s. 6d. Gas coke is quiet, but makers hold firm at 18s. for best qualities.

## SCOTLAND.

*(From our own Correspondent.)*

### Shipbuilding.

DURING the month of July six vessels of 16,541 tons aggregate were launched from Clyde yards. For this year to date forty-two vessels of 120,412 tons aggregate have been launched, compared with 125 vessels of 325,018 tons during the same period last year. Only one new order was reported in July. A few inquiries are mentioned, but there seems little likelihood of any substantial orders being placed in the near future. The amount of idle tonnage laid up in the Firth and the upper reaches of the Clyde increased by almost 50,000 tons during July, the total being now sixty-two vessels of 246,890 tons aggregate.

### Shale Oil Industry.

A deputation from West Lothian County Council, Mr. William Graham, President of the Board of Trade, and Mr. E. Shinwell are to meet to discuss the present crisis in the Scottish shale oil industry. The memorial to be presented by the deputation points out that if the Government offers the necessary assistance the companies are prepared to face a modified loss, if the workers accept a 5 per cent. reduction in wages. In this area one-fourth of the whole population would be affected, as there are no other industries unless those dependent on the shale oil industry. The closing down of the works has directly affected 5000 workers, and indirectly some 2000 employees. The coal industry will suffer directly as it is, estimated that 1000 miners are required to provide the 365,000 tons of coal consumed annually at the shale mines and shale oil works, and it will not be an easy matter to find a new market for that amount of fuel. In conclusion, it is pointed out that the members of the deputation understand that facts and figures have already been presented to the Government to prove that without outside aid the Scottish shale oil industry may soon cease to exist.

### Steel and Iron.

The steel and iron works are just restarting after a longer holiday than usual. In all departments business has been extremely dull for a considerable period, and so far as can be ascertained, little improvement can be looked for in the meantime at least, the amount of business which has accumulated during the stoppage being rather disappointing. Steel plates and sections are greatly in need of orders, and prospects in the sheet and tube departments are not encouraging. Reports from the bar iron, steel re-rolling, and pig iron branches are similar. Business in all three, but especially in the last named, is distinctly poor. Though prices generally are unchanged, the tone is weak. Re-rolled steel bars are now quoted £6 per ton home and export, and galvanised corrugated sheets 24 g. for export £9 15s. per ton, f.o.b. Glasgow.

### Coal.

The Scottish coal market continued almost at a standstill throughout the past week. The miners in the Lothians and Lanarkshire made a fair restart after the holidays, but in Fifeshire the men were very slow to return, but an improvement in this respect is expected now that the wages question has been settled. Home demands have been further restricted, owing to prolonged holidays at the steel and iron works. Export business has been rendered practically impossible by the uncertainty existing in the industry, and the curtailment of outputs. Neither collieries nor shippers have been able to entertain forward business, and attentions have been almost entirely directed towards deliveries of coal against existing contracts. The feature of the market has been the firmness of double nuts and Fife navigations. Aggregate shipments amounted to 155,760 tons, against 86,956 tons in the preceding week, and 182,281 tons in the same week last year.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

### The Coal Trade.

THE holidays are very largely responsible for this week being about the quietest throughout the whole year, inasmuch as there was no work in the coalfield for the first three days, and the docks were idle for the first two days of the week. So far as business is concerned it will be next week before anything like settled conditions will prevail; but so far as can be seen comparatively little fresh inquiry for steam coals has come to hand during the vacation, and most exporters had made arrangements a week or more ago for the loading of any tonnage due to arrive this week. One satisfactory feature is that the shipments from this district last week marked an improvement upon the totals of the last two or three weeks. The returns of the Great Western Railway Company for the six ports under its control in this area showed that the quantity of all coals shipped came to 447,830 tons, which was just over 57,000 tons more than for the preceding week, though the total is less than for the corresponding period of last year by about 56,000 tons. There was, naturally, a big exodus of tonnage from the local docks last week, as special efforts were made to complete steamers and get them away before the holidays. The result was that on Saturday the number of idle tipping appliances at the various docks reached the abnormally high figure of fifty-six. Fortunately, since then tonnage has arrived to improve the position for collieries, though it cannot be said that there is any real pressure to load. Business for all directions is unquestionably extremely quiet. A few isolated orders are about for single cargoes, but the competition for them is so keen that those who eventually get the business are fortunate if there is any profit in it. Contract operations are also on the dull side, and, so far as the Egyptian State Railways are concerned, it is now reported that they have deferred for a time the placing of any further business. It was understood that it was their intention to follow up their recent purchase of 100,000 tons of locomotive coals on a c.i.f. basis by buying a further similar quantity on an f.o.b. basis.

### French Coal Licences.

Since writing a week ago slightly better news has come to hand regarding the position for the month of August. It will be recalled that a deputation representative of the coalowning and coal exporting interests of this country met the French Premier and others in Paris last week in order to make an endeavour to secure some concessions. Reports had come to hand that arising from the operation of the French licensing scheme for limiting the import of foreign coals, other countries had obtained some concessions, and naturally the feeling prevailed that this country should in all the circumstances receive favourable consideration. The arrangement come to is that the United Kingdom is entitled to ship to France during the current month a total quantity of coal equal to the average exports in August, 1928, 1929, and 1930. The French decree originally provided that exports in future were to be the average of those three years less 20 per cent. If the revised quota is not fully absorbed during this month then the balance will be carried forward to September, but it appears that it has also been made quite clear that, as from the beginning of September, no special concessions will be granted to any country and that all will be dealt with on an equal footing. As a matter of fact, shipments during the month of August are usually at about their lowest level, but the figures show that, taking the average of shipments for the three years in question, the quantity for South Wales works out at approximately 495,000 tons. If a 20 per cent. reduction had been carried into operation this would have meant that the quantity would be about 395,000 tons, so that it will be seen that South Wales has gained to the extent of about 100,000 tons, assuming that this district gets its fair proportion of shipments for the whole of the United Kingdom.

### Tin-plate Items.

It is reported that the tin-plate works at Pontyclun, belonging to Richard Thomas and Co., Ltd., which normally give employment to about 200 men, are to be re-started on August 10th. The ascertainment governing wages in the Welsh tin-plate industry show that wages for the next quarter will remain unchanged, the average selling price of tin-plate being practically the same as the previous quarter. A fall of about 3s. from the average price for the previous three months is recorded in the ascertainment for the quarter ended June 30th of the average price of Siemens steel bars. The price which will govern the wages of South Wales steel workers for the three months commencing August 3rd worked out at £4 14s. 5·362d., as compared with £4 17s. 4·021d. for the preceding quarter.

### South Wales Industrial Council.

It is reported that the Government is prepared to encourage the setting up of a development council for South Wales on lines similar to that which is operating in Lancashire and Yorkshire. The Lord Privy Seal has already discussed the subject with members of the Welsh Parliamentary Party, and a sub-committee is to further the matter after discussing it with the civic heads of the leading centres in this area. The probability is that a conference of municipal representatives will later be held at Cardiff, when the Lord Privy Seal is prepared to attend and explain the council's functions. It is understood that he is ready to give every assistance if local representatives display enthusiasm towards the proposal.

### Notices to Miners.

Notices have been given to 450 men at the Big Vein Pit at Tirpentwys to cease work in a fortnight's time. In the North Wales coalfield similar notices have been tendered to the workmen at the Hafod Collieries, which are among the largest in that area. Over 2000 men are affected. The notices will take effect on the 19th inst. These collieries have been worked for nearly seventy years.

### Super Electricity Station.

Expectations are held that work will be started in the immediate future on the super electricity generating station to be erected at Tir John North, Swansea. The Swansea Town Clerk received last week a letter from the Unemployment Grants Committee intimating that it was recommending that a grant be made from the Exchequer funds towards the cost of the new station, estimated at £1,319,000. The grant would be 100 per cent. of the interest up to December 31st, 1934, and thereafter 50 per cent. up to March 31st, 1945, subject to the usual conditions of Government grants of this description. Preparatory work, it is understood, will be begun immediately, so that the actual erection of the station itself and other works may be started as soon as possible.

### Current Business.

Operations in steam coals this week have been practically at a standstill owing to the holidays, and prices are largely nominal, though for the most part minimum schedule figures prevail. Dry nuts form about the steadiest section of the market, all other qualities, notwithstanding the limitation of production by reason of the vacation, being in good supply. Small coals are particularly excessive and there is no change in coke or patent fuel. Pitwood is also a quiet market.

## LAUNCHES AND TRIAL TRIPS.

STRATHAIRD, liner; built by Vickers-Armstrong, Ltd., to the order of Peninsular and Oriental Steam Navigation Company; dimensions, 664ft. by 80ft. by 46ft. 6in.; to carry passengers and cargo. Engines, turbo-electric propulsion; launch, July 18th.

HILARY, single-screw steamer; built by Cammell Laird and Co., Ltd., to the order of Booth Steamship Company; dimensions, 420ft. by 56ft. by 37ft.; to carry passengers and cargo. Engines, triple-expansion; constructed by the builders; trial trip, July 27th.

## CATALOGUES.

TANGYES, Ltd., Cornwall Works, Birmingham.—List No. 424 of "Garage Equipment."

FOSTER WHEELER, Ltd., Aldwych House, Aldwych, W.C. 2.—Particulars of the Tracy steam purifier.

IGRANIC ELECTRIC, Ltd., 149, Queen Victoria-street, E.C. 4.—Leaflets on magnetically operated switches.

DAVIES AND METCALFE, Ltd., Romiley, near Manchester.—A descriptive brochure of the D. and M. vacuum brake ejector.

DE BERGUE AND CO., Ltd., Strangeways Ironworks, Manchester.—Details of the De Bergue countersunk riveting process.

VACUUM OIL COMPANY, Ltd., Caxton House, S.W. 1.—Gargoyle Technical Series No. 35 on "The Lubrication of Steam Wagons."

GEORGE FLETCHER AND CO., Ltd., Derby.—General plant units catalogue, which includes chemical plant, evaporators, mixers, dryers, &c.

W. FORREST AND CO., Sylvester-gardens, Sheffield.—Descriptive pamphlet of a double-ended wet tool grinder for alloy cutting tools.

STAVELEY COAL AND IRON COMPANY, Ltd., near Chesterfield.—A brochure describing in some detail the manufacture of sand spun pipes.

W. T. GLOVER AND CO., Ltd., Trafford Park, Manchester.—Pamphlet containing a number of illustrations of buildings wired with the company's cables.

"MARCO" CONVEYOR AND ENGINEERING COMPANY, Rowin Works, Leytonstone, E. 11.—Pamphlet on conveyors, elevators, and general handling plants.

J. B. BROOKS AND CO., Ltd., Great Charles-street, Birmingham.—A leaflet giving prices and particulars of "Evertaut" steel stools, chairs, furniture, &c.

W. H. COLT, Ltd., Bush House, Aldwych, W.C. 2.—Particulars of the "Coltagraph," an instrument for checking by graph the working time of a machine or running time of vehicles.

ASPINALL'S PATENT GOVERNOR COMPANY, 10, Strand-street, Liverpool.—An illustrated descriptive catalogue of Aspinall's patented governing specialities for marine and land engines.

BRITISH ALUMINIUM COMPANY, Ltd., Adelaide House, King William-street, E.C. 4.—A new publication on aluminium in shop fitting; also "Aluminium in Architecture and Decoration."

MARSHALL, SONS AND CO., Ltd., Gainsborough.—Publication No. 2194, describing the firm's new Diesel road roller; and Publication No. 1967/1 on high economy superheated steam semi-portable "Locomobile" engines.

BURTON, GRIFFITHS AND CO., Ltd., Montgomery-street, Sparkbrook, Birmingham.—A range of catalogues issued by the American Instrument Company, for whom Burton, Griffiths and Co., Ltd., are the sole agents in Great Britain.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. Coast— | |
| (1) Native | 16/- to 20/6 |
| (1) Spanish | 14/- |
| N.E. Coast— | |
| Native | 18/- to 21/- |
| Foreign (c.i.f.) | 14/6 |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) Scotland— | | |
| Hematite | 3 10 0 | — |
| No. 1 Foundry | 3 13 6 | — |
| No. 3 Foundry | 3 11 0 | — |
| N.E. Coast— | | |
| Hematite Mixed Nos. | 3 1 6 | 3 1 6 |
| No. 1 | 3 2 0 | 3 2 0 |
| Cleveland— | | |
| No. 1 | 3 1 0 | 3 1 0 |
| Siliceous Iron | 3 1 0 | 3 1 0 |
| No. 3 G.M.B. | 2 18 6 | 2 18 6 |
| No. 4 Foundry | 2 17 6 | 2 17 6 |
| No. 4 Forge | 2 17 0 | 2 17 0 |
| Mottled | 2 16 6 | 2 16 6 |
| White | 2 16 6 | 2 16 6 |
| Midlands— | | |
| (c) Staffs.— | (*Delivered to Station.*) | |
| All-mine (Cold Blast) | — | — |
| North Staffs. Forge | 3 1 0 | — |
| „ „ Foundry | 3 6 0 | — |
| (c) Northampton— | | |
| Foundry No. 3 | 3 2 6 | — |
| Forge | 2 17 6 | — |
| (c) Derbyshire— | | |
| No. 3 Foundry | 3 6 0 | — |
| Forge | 3 1 0 | — |
| (3) Lincolnshire— | | |
| No. 3 Foundry | — | — |
| No. 4 Forge | — | — |
| Basic | — | — |
| (4) N.W. Coast— | | |
| N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | 3 15 6 (a); 4 0 6 (b); 4 5 6 (c) | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| Scotland— | | |
| Crown Bars | 10 5 0 | 9 15 0 |
| Best | — | — |
| N.E. Coast— | | |
| Iron Rivets | 11 5 0 | — |
| Common Bars | 10 10 0 | — |
| Best Bars | 11 0 0 | — |
| Double Best Bars | 11 10 0 | — |
| Treble Best Bars | 12 0 0 | — |
| Lancs.— | | |
| Crown Bars | 9 15 0 | — |
| Second Quality Bars | 8 5 0 | — |
| Hoops | 12 0 0 | — |
| S. Yorks.— | | |
| Crown Bars | 9 15 0 | — |
| Best Bars | 10 15 0 | — |
| Hoops | 12 0 0 | — |
| Midlands— | | |
| Crown Bars | 9 5 0 to 10 7 6 | — |
| Marked Bars (Staffs.) | 12 0 0 | — |
| Nut and Bolt Bars | 8 7 6 to 9 0 0 | — |
| Gas Tube Strip | 10 12 6 | — |

## STEEL. (*d*)

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) Scotland— | | |
| Boiler Plates (Marine) | 10 10 0 | 10 10 0 |
| „ „ (Land) | 10 10 0 | 10 0 0 |
| Ship Plates, ½in. and up | 8 15 0 | 7 15 0 |
| Sections | 8 7 6 | 7 7 6 |
| Steel Sheets, ¼in. | 7 10 0 | 7 10 0 |
| Sheets (Gal. Cor. 24 B.G.) | 11 7 6 | 9 15 0 |

## STEEL (*continued*).

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. Coast— | | |
| Ship Plates | 8 15 0 | 7 15 0 |
| Angles | 8 7 6 | 7 7 6 |
| Boiler Plates (Marine) | 10 10 0 | — |
| „ „ (Land) | 10 0 0 | — |
| Joists | 8 15 0 | 7 7 6 |
| Heavy Rails | 8 10 0 | — |
| Fish-plates | 12 0 0 | — |
| Channels | 10 5 0 | £9 to £9 5s. |
| Hard Billets | 8 2 6 | — |
| Soft Billets | 6 17 6 | — |
| N.W. Coast— | | |
| Barrow— | | |
| Heavy Rails | 8 5 0 | — |
| Light Rails | 8 10 0 to 8 15 0 | — |
| Billets | 6 10 0 to 9 0 0 | — |
| Manchester— | | |
| Bars (Round) | 9 7 6 | — |
| „ (Small Round) | 6 10 0 | — |
| Hoops (Baling) | 10 0 0 | 9 15 0 |
| „ (Soft Steel) | 9 0 0 | 8 15 0 |
| Plates | 8 17 6 to 9 2 6 | — |
| „ (Lancs. Boiler) | 9 0 0 | — |
| Sheffield— | | |
| Siemens Acid Billets | 9 2 6 (basis) | — |
| Hard Basic | 8 2 6 and 8 12 6 | — |
| Intermediate Basic | 6 12 6 and 7 2 6 | — |
| Soft Basic | 6 0 0 | — |
| Hoops | 9 10 0 to 9 15 0 | — |
| Soft Wire Rods | 7 15 0 | — |
| Midlands— | | |
| Small Rolled Bars | 6 7 6 to 7 0 0 | — |
| Billets and Sheet Bars | 5 0 0 to 5 15 0 | — |
| Galv. Sheets, f.o.b. L'pool | 9 7 6 to 10 0 0 | — |
| (2) Staffordshire Hoops | 9 10 0 | — |
| (*d*) Angles | 8 7 6 | — |
| (*d*) Joists | 8 15 0 | — |
| (*d*) Tees | 9 7 6 | — |
| (*d*) Bridge and Tank Plates | 8 17 6 | — |
| Boiler Plates | 9 0 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| Swansea— | |
| Tin-plates, I.C., 20 by 14 f.o.b. | 13/6 to 13/9 |
| Block Tin (cash) | 108 15 0 |
| „ (three months) | 110 17 6 |
| Copper (cash) | 32 17 6 |
| „ (three months) | 33 15 0 |
| Spanish Lead (cash) | 12 15 0 |
| „ „ (three months) | 12 11 3 |
| Spelter (cash) | 11 17 6 |
| „ (three months) | 12 3 9 |
| Manchester— | |
| Copper, Best Selected Ingots | 36 10 0 |
| „ Electrolytic | 37 15 0 |
| „ Strong Sheets | 66 0 0 |
| „ Tubes (Basis Price), lb. | 0 0 10½ |
| Brass Tubes (Basis Price), lb. | 0 0 9½ |
| „ Condenser, lb. | 0 0 11½ |
| Lead, English | 14 0 0 |
| „ Foreign | 12 12 6 |
| Spelter | 12 5 0 |
| Aluminium (per ton—raw ingot) | £85 |

## FERRO ALLOYS.

| | Per Ton. | Per Unit. |
|---|---|---|
| Tungsten Metal Powder | 1/11½ per lb. | |
| Ferro Tungsten | 1/8½ per lb | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £21 0 0 | 7/- |
| „ „ 6 p.c. to 8 p.c. | £20 12 6 | 7/- |
| „ „ 8 p.c. to 10 p.c. | £19 17 6 | 7/- |
| „ „ Specially Refined | | |
| „ „ Max. 2 p.c. carbon | £30 0 0 | 10/- |
| „ „ „ 1 p.c. carbon | £34 0 0 | 12/- |
| „ „ „ 0·70 p.c. carbon | £36 0 0 | 14/- |
| „ „ „ carbon free | 9½d. per lb. | |
| Metallic Chromium | 2/7 per lb. | |
| Ferro Manganese (per ton) | £11 0 0 for home | |
| „ „ „ | £11 10 0 for export | |
| „ Silicon, 45 p.c. to 50 p.c. | £10 10 0 scale 5/- per unit | |
| „ „ 75 p.c. | £15 0 0 scale 7/- per unit | |
| „ Vanadium | 12/9 per lb. | |
| „ Molybdenum | 4/2 per lb. | |
| „ Titanium (carbon free) | 9d. per lb. | |
| Nickel (per ton) | £170 | |
| Ferro Cobalt | 8/9 per lb. | |

## FUELS.

### SCOTLAND.

| | Export. |
|---|---|
| Lanarkshire— | |
| (f.o.b. Glasgow)—Steam | 13/6 |
| „ „ Ell | 14/3 |
| „ „ Splint | 14/6 to 15/9 |
| „ „ Trebles | 12/- to 12 6 |
| „ „ Doubles | 11/6 to 11/9 |
| „ „ Singles | 10/6 |
| Ayrshire— | |
| (f.o.b. Ports)—Steam | 13/6 |
| „ „ Jewel | 17/- |
| „ „ Trebles | 12/6 |
| Fifeshire— | |
| (f.o.b. Methil or Burntisland)—Steam | 10/6 to 12/6 |
| Screened Navigation | 16/6 to 17/6 |
| Trebles | 12/- to 13/6 |
| Doubles | 12/- |
| Singles | 10/6 |
| Lothians— | |
| (f.o.b. Leith)—Best Steam | 11/- |
| Secondary Steam | 10/6 |
| Trebles | 12/6 |
| Doubles | 12/- |
| Singles | 10/6 |

### ENGLAND.

| | |
|---|---|
| (8) N.W. Coast— | |
| Steams | 20/- |
| Household | 30/- to 51/- |
| Coke | 20/- to 20/6 |
| Northumberland— | |
| Best Steams | 13/6 |
| Second Steams | 12/- |
| Steam Smalls | 7/6 to 8/- |
| Unscreened | 12/6 to 13/- |
| Household | 27/- to 39/- |
| Durham— | |
| Best Gas | 14/6 |
| Second | 13/3 to 13/6 |
| Household | 25/- to 37/- |
| Foundry Coke | 24/- |
| Sheffield— | Inland. |
| Best Hand-picked Branch | 24/6 to 25/6 — |
| Derbyshire Best Bright House | 19/- to 20/- — |
| Best House Coal | 18/6 to 20/- — |
| Screened House Coal | 17/- to 18/- — |
| „ „ Nuts | 14/6 to 15/- — |
| Yorkshire Hards | 15/- to 16/6 — |
| Derbyshire Hards | 15/- to 16/6 — |
| Rough Slacks | 8/6 to 9/6 — |
| Nutty Slacks | 6/- to 7/6 — |
| Smalls | 4/- to 5/6 — |
| Blast-furnace Coke (Inland) | 12/3 on rail at ovens |
| Furnace and Foundry Coke (Export), f.o.b. | 13/- to 14/- |

### (9) SOUTH WALES.

| | |
|---|---|
| Cardiff— | |
| Steam Coals: | |
| Best Smokeless Large | 20/- |
| Second Smokeless Large | 18/9 to 19/9 |
| Best Dry Large | 18/6 to 19/3 |
| Ordinary Dry Large | 17/9 to 18/- |
| Best Black Vein Large | 18/3 to 18/9 |
| Western Valley Large | 18/- to 18/6 |
| Best Eastern Valley Large | 17/9 to 18/- |
| Ordinary Eastern Valley Large | 17/9 to 18/- |
| Best Steam Smalls | 13/6 to 14/- |
| Ordinary Smalls | 11/- to 13/- |
| Washed Nuts | 18/- to 21/- |
| No. 3 Rhondda Large | 19/9 to 20/- |
| „ „ Smalls | 15/- to 16/- |
| No. 2 „ Large | 17/- to 17/3 |
| „ „ Through | 15/6 to 16/- |
| „ „ Smalls | 14/- to 14/3 |
| Foundry Coke (Export) | 22/- to 26/6 |
| Furnace Coke (Export) | 16/6 to 17/6 |
| Patent Fuel | 19/9 to 20/- |
| Pitwood (ex ship) | 21/6 to 22/- |
| Swansea— | |
| Anthracite Coals: | |
| Best Big Vein Large | 35/- to 37/6 |
| Seconds | 27/- to 31/6 |
| Red Vein | 22/6 to 27/6 |
| Machine-made Cobbles | 41/6 to 45/- |
| Nuts | 40/- to 46/- |
| Beans | 24/9 to 28/3 |
| Peas | 21/- to 21/9 |
| Breaker Duff | 8/6 to 9/6 |
| Rubbly Culm | 8/6 to 9/- |
| Steam Coals: | |
| Large | 20/- to 20/6 |
| Seconds | 18/- to 20/- |
| Smalls | 11/6 to 13/- |
| Cargo Through | 16/- to 17/6 |

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

# French Engineering Notes.

*(From our own Correspondent in Paris.)*

### Financing Trade.

APART from the orders for railway and other material which are expected to be distributed by the colonies now that extensive credits have been voted for that purpose, there is little prospect of new orders being given out so long as public works undertakings are held up through the delay in carrying out the necessary financial arrangements. Manufacturers, therefore, look more particularly to the financing of foreign markets, which has proved quite successful in the past, and may bring in a large volume of work at a time when this country seems to be the only one with sufficient liquid capital to enable it to embark upon such operations. The Schneider group has made a loan to the Government of Latvia, which will be paid partly in cash and partly in kind, the latter consisting largely of railway material, and it is hoped that the orders placed in Germany by the Soviet Government will come to this country in view of the supposed inability of Germany to execute the work under the stipulated conditions of credit. The resumption of commercial arrangements with the Soviet has changed the attitude of French manufacturers towards the Russian business, and it is probable that credits will be readily given for orders that are offered by that country. If Germany is unable to comply with the credit requirements for the 500 million marks' worth of orders placed during the first six months of the year, the French will make efforts to secure a transference of as much of the business as they can. Otherwise the immediate outlook is by no means encouraging. The engineering trades are, nevertheless, not without some confidence, based upon the belief that, when the arrangements being carried out for a continuance of the national scheme of public works and for the colonial undertakings are completed, there will be sufficient employment to enable the country to hold out for some years to come.

### The Congo Railway.

A recent official statement to the effect that the railway being laid between Brazzaville and Pointe-Noire on the coast would be opened in 1934 is obviously premature, in view of the extraordinary difficulties being encountered in its construction. Although the railway was begun ten years ago, the route is not even yet entirely surveyed. There was a good deal of haste in the preparations for this undertaking, because communication with Equatorial Africa is at present only possible by the Congo to Brazzaville, and the French have to rely upon the Belgian Congo Railway. The only outlet to the ocean is at Pointe-Noire, and the territory to be traversed by the railway is exceedingly difficult, with jungle and swamps and the barrier of the Mayombé range. There are seventeen tunnels and thirty-nine viaducts to be constructed. Even the exact length of the railway is unknown, as it will depend upon further surveys beyond Mayombé, but it will be between 320 and 330 miles. It was at first intended to construct a light railway, and the work accomplished had to be done over again when it was decided to lay down a standard-gauge track. The initial labour difficulties, when thousands of natives died in the jungle and swamps, are now a matter of history, and with the use of labour-saving plant and the provision of an adequate medical service the mortality has been considerably reduced. It is stated that the line has been laid for a length of 61 miles and that 32 miles of it occupied seven years in construction, since the work was suspended as the result of the disastrous native mortality. Since the work was resumed fair progress has been made, and it will be accelerated with a plant which will lay the track at the rate of 1500 m. a day, but it is impossible to say, even approximately, when the line will be completed.

### Railway Deficits.

The railway debenture holders have informed the Government that they intend to hold the State responsible for the losses they are incurring through the heavy deficits, which continue to increase. Though the Government has decided to allow the companies to raise passenger rates and has reduced the fiscal tax on passenger fares, nothing will be done until the proposals are submitted to Parliament after the vacation, and bondholders affirm that all the trouble arises from the fact that the Government has placed the railway administration under the control of Parliament instead of adopting the recommendations of the Superior Council, as it is entitled to do. Had the Government not resorted to the Chamber of Deputies on every occasion, it is probable that the railways would have avoided the disaster that has overtaken them, for the Convention of 1921 empowered the State to advance money to the companies to enable them to tide over temporary difficulties and to raise the railway rates when required to make up for any deficit. The 32 per cent. tax on passenger fares was intended as a temporary expedient while the franc was being stabilised, and its continuance was in no way justified.

### African Air Service.

The arrangements for an air service between Brussels and the Belgian Congo by way of Paris, Algeria, the Sahara Desert and French Equatorial Africa have been completed, and it is hoped to start the service for goods transport next spring, to be followed a few months later by a service for passengers. It will be operated by companies in which the respective States will have a controlling interest, the Belgian company being known as the "Sabena" and the French the "Sadan." Aircraft manufacturing interests will be excluded from them. The work of laying out the route is already making progress. There will be ten regular landing grounds and fifty-one emergency grounds. On each side of the desert, at Gao and Aoulef, there will be powerful lights, and other lights will be installed on some sections for night flying.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

*Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## SWITCHGEAR.

351,739. June 26th, 1930.—ELECTRIC SWITCHES, Maschinenfabrik Oerlikon, of Oerlikon, near Zürich, Switzerland.

It is well known that, with switches having freely abutting block contacts, when the switch mechanism is defective and the contacts make contact on only one side—as shown in Fig. 1—the current flows along curved paths which lead to magnetic repulsion tending to separate the contacts A and B. According to the invention, the curved paths which the current follows

N°351,739

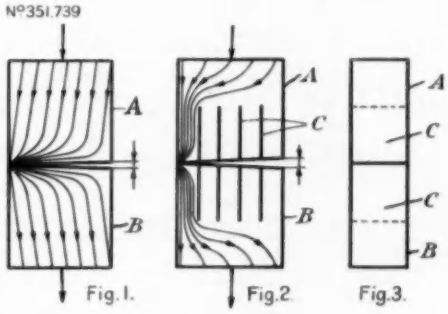



Fig. 1. Fig. 2. Fig. 3.

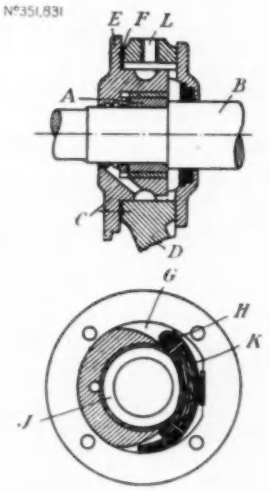
are rendered ineffective as regards separating the contacts, by artificially increasing the distance between the curved paths of the current in the two contacts, by the provision of saw cuts or slits C—Figs. 2 and 3—in the switch contacts A, B, in a direction perpendicular to that of the curved current paths tending to cause separation of the contacts; that is to say, normally perpendicular to the plane or line of contact of the block contacts. —*July 2nd*, 1931.

## TRANSMISSION OF POWER.

351,831. September 18th, 1930.—BEARINGS, Siemens-Schuckertwerke Aktiengesellschaft, Berlin-Siemensstadt, Germany.

Machines which are to run noiselessly must, say the inventors, be provided with plain bearings, as a singing noise is practically always unavoidable with roller bearings. Plain bearings have, however, in general, a greater axial length than the usual roller bearings calculated for the same bearing pressure. It is consequently not possible easily to substitute plain bearings for roller bearings. According to the invention, an interchangeability of plain and roller bearings is attained by using a runner ring A of hard steel fitted on a motor shaft B. In order to protect the ring from sliding off the shaft, the pedestal body C is inserted in the bore of the bearing bracket D. The pedestal body is provided on its outer side with a flange E by means of which it

N°351,831




is screwed by bolts against the bearing bracket. Between the flange E and the bearing bracket are inserted packing shims F, by the number and thickness of which the axial bearing play can be regulated. The bearing body is provided with an excentric recess G, in which is arranged the lubricating wick H. The wick is forced against the ring J by a flat spring K. The oil is supplied through the lubricating hole L already existing in the ordinary bearing bracket. Channels are provided in the pedestal body for the return flow of the oil. By means of the plain bearing constructed according to the invention, it is, it is claimed, possible to fit up ordinary motors with ordinary bearing brackets, without any alteration with roller or plain bearings as desired.—*July 2nd*, 1931.

## PUMPING AND BLOWING MACHINERY.

351,875. October 30th, 1930.—MULTI-STAGE CENTRIFUGAL PUMPS, G. Weyland, Lambsheimerstrasse 40, Frankentha (Pfalz, Germany).

High-pressure centrifugal pumps for pumping hot liquid, which is heated between two pressure stages, have, says the inventor, recently been used frequently. These pumps possess advantages as boiler feed pumps for high-pressure boilers because owing to the two-pressure stage system the feed-water heater is at a pressure which is less than the boiler pressure. The working difficulties with such pumps reside more particularly in the pressure stuffing-boxes, because it is difficult to keep them tight at high temperatures and pressures. The axial thrust produced in such centrifugal pumps is taken up by a hydraulic relief device of known construction. The relief device allows some water under pressure to pass through, which in normal pumps flows away freely. In boiler feed centrifugal pumps this relief water is valuable, and therefore it has to be returned in a closed pipe line. If now this highly preheated relief water is led into the suction connection of the pump or into the feed-water tank, some of it, owing to the release of pressure, will be transformed into steam and will endanger the safe working of the pump. Heretofore, in order to avoid this, the relief water has been cooled down separately. The invention consists in connecting the sealing liquid chamber and the leakage water chamber to the same pressure stage, the sealing liquid chamber being connected to the outlet connection for the non-preheated pumped liquid, while the leakage water chamber is connected to the inlet connection for the preheated liquid. The advantage is thereby attained that the drop in pressure produced in the inlet connection by the resistances to the pumped liquid in the feed-water heater is utilised to produce the differences in pressure and temperature in the sealing liquid chamber and in the

N°351,875

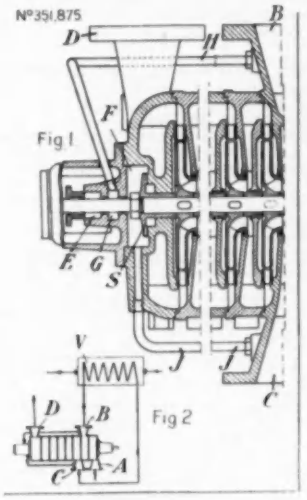



Fig 1. Fig 2.

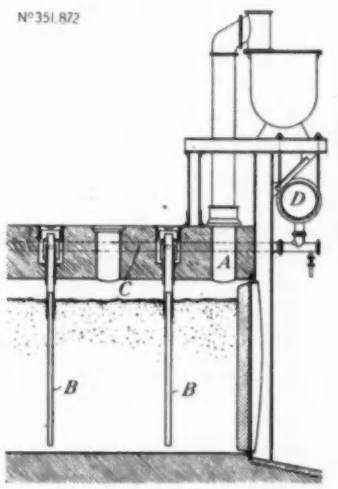
leakage water chamber. As a constructional example, a pump —Fig. 2—has been selected for the specification in which the first two stages are used to produce the feed-water heater pressure and a further six stages in order to bring the hot water coming from the feed-water heater to the boiler pressure. In the second pressure stage between the connections C and D heat is neither supplied to nor taken from the hot water. Therefore, in the leakage water chamber F, behind the relief plate S, the same temperature and the same pressure prevail as in the connection C. These two chambers are connected together by the pipe line J, thus balancing the pressure. The sealing liquid chamber G between the stuffing-box E and the leakage water chamber F is connected by the pipe line H with the outlet connection B for the non-preheated water, so that the water which is not yet preheated is supplied to the sealing liquid chamber G at a pressure higher than that prevailing in the leakage water chamber F. In this way hot water is prevented from entering the stuffing-box E and at the same time the drop in pressure produced in the inlet connection C through the resistances to the pumped liquid in the feed-water heater V is utilised for producing the differences in temperature and pressure in the sealing liquid chamber G and the leakage water chamber F.—*July 2nd*, 1931.

## GAS PRODUCERS.

351,872. October 27th, 1930.—COKE OVENS, C. Still, Recklinghausen, Westphalia, Germany.

In this coke oven an endeavour is made to encourage the rapid passing away of the gases of distillation, and by these means accelerate the heating of the interior mass of the charge. The oven has the usual ascension pipe A for the gas evolved, and also a series of pipes B B which depend into the charge and lead away the gases by way of the piping system C D. The pipes B

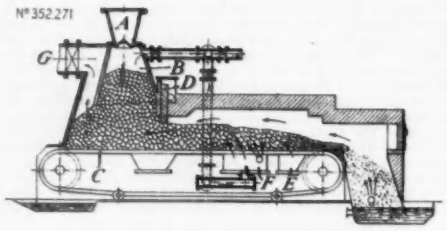
N°351,872




are perforated and their connections with the main C are controlled by valves. The upper part of these pipes is made in two telescopic parts. When the time arrives for the discharge of the coke the upper part of the telescope is raised, but no attempt is made to pull out the length of pipe B, as it is gripped in the bed of coke. The whole mass is, however, pushed out of the oven in the usual manner, and the pipes are recovered for further use when the coke has been quenched.—*July 2nd*, 1931.

352,271. July 18th, 1930.—Gas Producers, A. J. A. Hereng, 12, rue Charles Nodier, Paris, France.

This producer has a travelling chain grate. The fuel is fed through the hopper A into the vertical retort B and is drawn

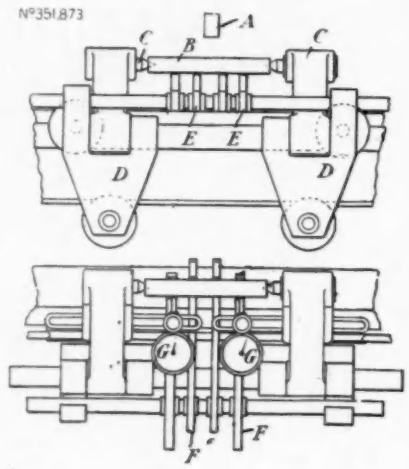



forward by the chain grate C under the bridge D. Air for combustion is provided at E, and any gases which may be distilled off in the vertical retort are returned to the charge at F. The resultant gases are taken off at G and the ashes fall into the water trough.—*July 9th*, 1931.

## MACHINE TOOLS AND SHOP APPLIANCES.

351,873. October 27th, 1930.—Apparatus for Straightening Shafts, C. Hurth, H. Hurth, F. Hurth, L. Hurth, and D. Schiefelbein, 19, Holzstrasse, Munich, Germany.

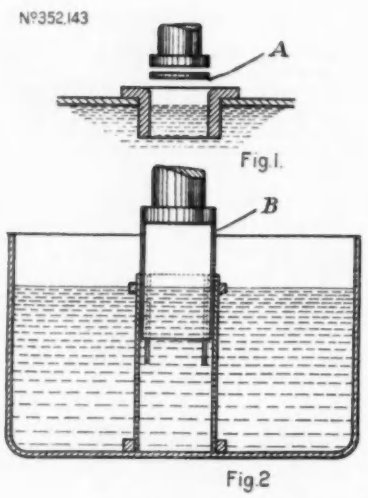
The ram of this straightening machine is shown at A, and the shaft to be straightened at B. The shaft is mounted between




centres C C on the wheeled carriage D D. This carriage embodies a table on which blocks E E are supported. These blocks can be arranged under the shaft by means of their tangs F F to support it appropriately while the ram A is used for straightening. Two or more dial gauges G G are provided for testing the straightness of the shaft.—*July 2nd*, 1931.

352,143. May 5th, 1930.—The Manufacture of Piston Rings, W. A. Oubridge, Parklands, Park-road, Coventry; A. J. Viner, Brockenhurst, Cromwell-lane, Tile-hill, Coventry; and the British Piston Ring Company, Holbrook-lane, Coventry.

The inventors aim at the prevention of the distortion of iron

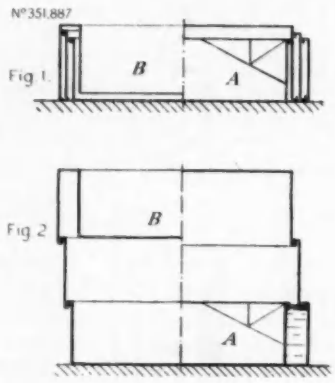



and steel articles during the process of hardening. The examples cited are the piston ring shown at A in Fig. 1 and the cylinder liner B in Fig. 2. In either case they are pressed through a die into the quenching medium so that they are forcibly shaped and held to that shape while they are being quenched.—*July 9th*, 1931.

## MISCELLANEOUS.

351,887. November 20th, 1930.—Telescopic Gasholders, Maschinenfabrik Augsburg-Nürnberg Aktiengesellschaft, Nürnberg 24, Germany.

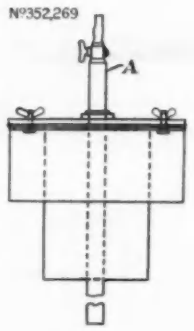
In the usual telescopic gasholders with water cup seal, the water container is mostly constructed as an annular vessel in order to economise in the cost of foundations, &c. The internal space of this annular vessel would act as a clearance or dead space of the gasholder if it was not limited by a cover, as is mostly the case, so that the bell of the holder, which constitutes the uppermost telescopic part, rests in its lowest position on this cover. In this way the dead space in the interior of the holder is removed, but a new dead space is produced underneath the gas space which normally is filled with air and therefore it is occasionally used as a storage space and the like. This space, however, constitutes a great source of danger if gas penetrates into it through the cover. In order to avoid such danger a water layer has now and then been provided on the said cover, which, however, is inconvenient. In telescopic gasholders with a sliding seal in which the uppermost telescopic member is the widest one and is in the form of a bell, an arrangement is provided according to the invention by which the dead space is avoided. With this object in view, the bell cover is turned inwards to such an extent that in the position of rest—that is to say, when the uppermost telescopic part is in its lowest position—it almost touches the bottom of the holder. Any space in which the gas can accumulate is thereby entirely avoided. Should any gas escape upwards




through the cover of the container into the turned-in part, it would not constitute a danger, since this space is connected with the outer atmosphere over its whole surface. By this new construction a great source of danger is, the inventors claim, avoided. The drawings illustrate, on the left-hand side of Fig. 1, the new construction, and the right-hand side the old form of construction by way of comparison. Fig. 2 shows the same containers in a filled-up condition. The dead space which is present in the old form of construction, and which in practice can never be avoided, is shown by A. In the new form of construction B is the upper bell, which, according to the invention, is turned inwards, which construction avoids any dead space in the holder as well as outside. The bell cover when in its lowermost position can consequently come to lie wholly or at individual points on the bottom of the gasholder or on supports provided thereat.—*July 2nd*, 1931.

352,269. July 17th, 1930.—Apparatus for Detecting Mineral Deposits, Dr. G. Laubmeyer, 19, Burgfeldstrasse, Kassel-Wilhelmshöhe, Germany.

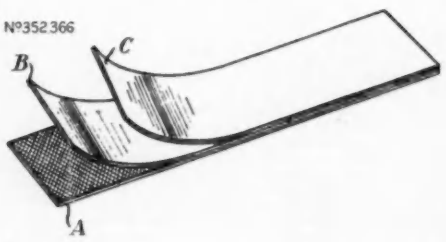
The inventor proposes to prospect for the existence of coal measures and such-like minerals by drilling into the earth, taking samples of the "air" from these holes and analysing this air for the presence of, say, hydrocarbons. The capping for the




hole is illustrated and comprises concentric cylinders, which are driven into the ground to keep out the atmosphere. The gear is to be left in place for from twenty-four to forty-eight hours and then a sample is taken from the pipe A for quantitative analysis. By drilling a number of holes and plotting the results of the analyses it is claimed that a seam may be located.—*July 9th*, 1931.

352,366. November 24th, 1930.—Insulating Tape, *International General Electric Company, Incorporated, of 120, Broadway, New York.*

For the insulation of winding coil heads for electric machines insulating materials prepared in the form of bands are used. The winding band described in this specification is claimed to cling very well to the surface of the bar or body on which it is wound, so that air spaces cannot occur. The layers hitherto wound on in two operations can be wound in one. Furthermore,




bands made according to the invention provide for insulation of the highest class. A indicates the insulating linen band, which is woven diagonally and impregnated with an insulating varnish, and it serves as a carrier for the mica layer B, which is cemented to it by means of an adhesive substance. The mica layer B is covered with impregnated fibrous material C—for example, tissue paper or cambric—which serves to protect the mica sheet and prevent its peeling. Both layers B and C are also connected with each other by means of an adhesive substance.—*July 9th*, 1931.

351,164. May 2nd, 1930.—Metallic Vapour Rectifiers, International General Electric Company, Incorporated, of 120, Broadway, New York.

As is well known, the cathode-receptacle of metallic vapour rectifiers must be attached with insulation to the iron container, otherwise the cathode-spot, or the arc, easily wanders up the casing, and leads to back-firings and other disturbances. The cathode-receptacle has, consequently, hitherto always been insulated from the iron container by the intermediate insertion of a procelain ring. With large sizes of porcelain rings, however, this is unsafe, since the ring is easily liable to burst, owing both to mechanical influences and to heat stresses. According to the invention, a very reliable insulation of the cathode-receptacle from the container is attained by the use of an insulating material consisting of aluminium, magnesium or an alloy of these metals with an oxidised surface. It is possible to form on aluminium, magnesium or their alloys, an oxide-layer of sufficient durability which will stand a pressure of 100 volts. According to the invention, the insulating member is conveniently made in the form of an oxidised ring of one of the above-mentioned metals, and by the employment of several such rings connected up in series the safety of the apparatus can be increased.—*June 25th*, 1931.

## Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

THURSDAY to SATURDAY, SEPTEMBER 3rd to 12th.

"Model Engineer" Exhibition.—Royal Horticultural Hall, Westminster, S.W. 1. Daily.

SUNDAY to SATURDAY, SEPTEMBER 6th to 12th.

International Association for Testing Materials.—Congress at Zürich.

THURSDAY to SATURDAY, SEPTEMBER 10th to 26th.

Shipping, Engineering and Machinery Exhibition.—Olympia, W. Daily, 11 a.m. to 9 p.m.

SATURDAY to WEDNESDAY, SEPTEMBER 12th to 16th.

International Foundry Congress.—Milan.

SATURDAY to SUNDAY, SEPTEMBER 12th to 27th.

International Foundry Exhibition.—At Milan.

SUNDAY to FRIDAY, SEPTEMBER 13th to 18th.

Institute of Metals.—Autumn meeting at Zürich. For programme see page 21.

FRIDAY to SUNDAY, SEPTEMBER 18th to 20th.

National Smoke Abatement Society.—Annual Conference at Liverpool.

FRIDAY to MONDAY, SEPTEMBER 18th to 21st.

Association of Special Libraries and Information Bureaux.—At Lady Margaret Hall, Oxford. Eighth annual conference. Friday evening, presidential address, by Professor A. M. Carr Saunders.

WEDNESDAY to FRIDAY, SEPTEMBER 23rd to 25th.

Institution of Mining Engineers.—Manchester. Postponed summer general meeting.

TUESDAY to FRIDAY, SEPTEMBER 29th to OCTOBER 2nd.

Iron and Steel Institute.—Autumn Meeting at Swansea. For programme see page 105.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

Messrs. Williams and Temple, consulting engineers, of Tower House, Chowrhinghee-square, Calcutta, inform us that they have taken over the practice of Mr. G. Bransby Williams at 28, Victoria-street, London, S.W. 1.

## CONTRACTS.

Richard Dunston, Ltd., shipbuilders, of Thorne, Yorkshire, have received an order from Grimsby owners for a steam cargo vessel, dimensions 104ft. 6in. by 20ft. by 8ft., which is intended for regular service between Grimsby and Hull.

Sulzer Brothers, Ltd., of Winterthur, Switzerland, have received an order from the St. Gallen-Appenzell Power Company for three oil engines, each developing 7400 B.H.P. at 187 revolutions per minute. These engines will be of the two-cycle double-acting type with airless injection.

Ruston and Hornsby, Ltd., of Lincoln, have received instructions from the Metropolitan Water Board to supply a further vertical oil engine—five-cylinder—for the Honor Oak Pumping Station. Two Ruston airless injection engines of 200 B.H.P. each were ordered in 1929 for the same station.

Merryweather and Sons, Ltd., of Greenwich-road, S.E. 10, have received orders from the London Fire Brigade for nine motor fire-engines, and for motor fire-engines from the Brigg, Wood Green, Consett fire brigades. The Dublin fire brigade has ordered a Merryweather all-British motor turntable fire ladder.

The University of Sheffield.—We understand that the Council of the University of Sheffield has decided to appoint a Professor of Electrical Engineering. It is hoped to make the appointment in time for the professor to take over his duties in the early part of 1932.

The City and Guilds of London Institute.—The Council of the City and Guilds of London Institute has conferred the distinction of Fellow of the Institute (F.C.G.I.) upon the following:—Mr. W. D. Dye, D.Sc., F.R.S., Mr. E. W. Marchant, D.Sc., Mr. H. M. Martin, M.I.M.E., Mr. J. Severs, M. Inst. C.E., M.I.M.E., Mr. F. Twyman, F.R.S. The Fellowship is conferred by the Council upon those who, having obtained the Associateship of the Institute and spent at least five years in actual practice, produce evidence of having done some original and valuable research work, or of having otherwise contributed to the advancement of the industry in which they are engaged.